



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

485 356

EARTH
SCIENCES
LIBRARY

BERKELEY
LIBRARY
UNIVERSITY OF
CALIFORNIA



SYMONS'S
MONTHLY
METEOROLOGICAL
MAGAZINE.

VOLUME THE TWENTY-FOURTH.

~~~~~  
**1889.**  
~~~~~

LONDON :
EDWARD STANFORD, COCKSPUR STREET, S.W.
—
1890.

70 .VIMU DC851
XINBOFLA S9
Y. 24-25

**EARTH
SCIENCES
LIBRARY**

INDEX.

	PAGE.		PAGE.
Annual Rainfall, Fluctuation of ...	167	Fog, London, and its effects on plants	53
Ash and the Oak, The	97, 120	Fluctuation of Annual Rainfall.....	167
Atmospheric Electricity	148	Gas Consumption and Fog.....	8
Anchor, or Ground Ice	21, 39, 59	German Meteorological Society	42
August 21st, Two Whirlwinds in Shropshire	114	Globular Lightning	10
Australia Floods, in.....	80	Great Rainfalls, Two—	
Australia, West, A wet time in ...	166	Sydney New South Wales,	
Autumn Congresses, The.....	129, 148	May 25th-28th	101
Barometer, The Old, in Salisbury Cathedral	11	Hong-Kong, May 29th-30th ...	101
Bavaria, Torrential Rains in	139	Ground Ice or Anchor Ice ...21, 39,	59
Ben Nevis, Sunshine and Rainfall at	149	Hailstones, Salt.....	105, 118, 169
Bermuda Halifax Cable, The Proposed : Its usefulness for weather predictions	54, 171	Heat, Practical Use of the Earth's Internal	48
Bibliography of Meteorology.....	49	Heligoland, Rainfall of	10, 24
Black Bulb Thermometer in Vacuo, On the.....	136, 149, 163, 182	Hong-Kong, Great Rainfall at	101
Boulogne, Thunderstorm at	64	Ice, Ground or Anchor.....	21, 39, 29
British Association at Newcastle-on-Tyne, The	129, 148	July 12th, Heavy Rain at St. Albans	96
Climatological Tables for the British Empire 12, 28, 44, 60, 76, 92, 108, 124, 138, 140, 156, 172,	184	July 13th, Exceptional Rainfall ...	112
Cloud Pictures	160	June, the Thunderstorms of May and	68
Cold Period, A	17, 72, 153	June 7th, Waterspout in Dorset	75, 84, 117
Congresses, The Paris Exhibition and its.....	81	Lightning, Dark Flashes of	150
Congresses, The Autumn	129, 148	Lightning, Globular.....	10
Congrès International Météorologique	150	Lightning Photographs	51, 150
Congres International d'Hydrologie et de Climatologie.....	152	London Fog and its effects on plants	53
Cornwall, Earthquake in.....	137	Loomis, Elias (Obituary).....	122
Dark Lightning Flashes	150	Lunar Rainbow	16, 169
Derwentwater, Floating Island	145, 167	March 8th and 9th, Floods of ...20,	33
Dorset, Waterspout in.....	75, 84, 117	May and June, The Thunderstorms of	68
Drought, The	87, 105	May 30th, Earthquake Shock	70
Earth's Internal Heat, Use of	48	Meteor, The Doubly Observed of November 4th	153, 161
Earthquake Shocks.....	70, 137	Meteorological Bibliography ...	49
Earthquake in Cornwall, Oct. 7th	137	Meteorological Notes on the Months 15, 31, 47, 63, 79, 95, 111, 127, 143, 159, 175,	187
Eiffel Tower, The, and its use	177	Meteorological Society, The Royal 9, 25, 42, 53, 74, 90, 170,	188
Electricity, Atmospheric.....	148	Meteorological Society, German ...	42
Errata, <i>Met. Mag.</i> , 1888, ...	119	Meteorological Society, The New England	65
Essex, Another Extraordinary Rain in	113	Météorologique Société de France... 3	
February 2nd, Thunderstorm of ...	10	Mont Blanc, Three Days on Top of Neumayer, Dr., Explanation ...155,	168
Floating Island in Lake Derwentwater, The	145, 167	New England Meteorological Society, The	65
Floods, The, of March 8th—9th 20,	33	Oak and the Ash, The	97, 120
Floods in Australia	80	OBITUARY :—	
Fog and Gas Consumption	8	Prof. Elias Loomis	122
		Rev. S. J. Perry	183
		Orleton, Absolute Droughts at	105

	PAGE.		PAGE.
Paris Exhibition, The, and its Congresses.....	81	Studierende und zum gebrauch in der Praxis.....	154
Perry, Stephen Joseph	183	In wie weit ist das heutige Klima Konstant.....	155, 168
Photographs of Lightning, Mr. Whipple on	51	Ergebnisse der Meteorologischen Beobachtungen im Systeme der Deutschen Seewarte, 1876-1885	155 168
Radiation, Solar 136, 149, 163,	182	Étude sur la synthèse de la Repartition des Pressions à la surface du Globe	165
Rain, Another Extraordinary in Essex	113	Rooks as Weather Indicators	41
Rain, Heavy at St. Albans, July 12th	96	Royal Meteorological Society, The	9, 25, 42, 53, 74, 90, 170, 188
Rains, Torrential in Bavaria	139	Royal Society Soirée	59
Rainbow, Lunar 16,	169	Salisbury Cathedral, The Old Barometer in	11
Rainfall and Sunshine, Ben Nevis ..	149	Salt Hailstones 105, 118,	169
Rainfall, Exceptional, July 13th ...	112	Salt Snow	27
Rainfall, Fluctuation of Annual ..	167	Sanitary Institute, The	151
Rainfall of Heligoland 10,	24	Severn, Anchor Ice on the	59
Rainfall, Trinidad	122	Sheep, Stampede, The, of November 3rd, 1888	153, 161
Rainfall, The Determination of the Amount of	130, 148	Shropshire, Two Whirlwinds, August 21	114
Rainfall and Temperature, Monthly 14, 30, 46, 62, 78, 94, 110, 126 142, 158, 174	186	Société Météorologique de France..	3
Rainfalls, Two Great	101	Solar Radiation.....136, 149, 163	182
Renou, M. E., Address to the Société Météorologique de France	3	Snow, Forms of, as Indicative of coming Weather	27
REVIEWS :—		Snow, Salt	27
Results of Meteorological Observations made in New South Wales during 1886	5	Snowstorm at Torquay	26
Results of Rain, River and Evaporation Observations made in New South Wales during 1887	5	St. Albans, Heavy Rain at, July 12th	96
Ueber eine nahezu 26-tägige Periodicität der Gewittererscheinungen	7	Sunshine and Rainfall at Ben Nevis	149
The Great Storm off the Atlantic Coast of the United States, March 11th to 14th, 1888 ...	36	Supplementary Tables of, Rainfall, 13, 29, 45, 61, 77, 93, 109, 125, 141, 157, 173	185
Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung	36	Sydney, N.S.W., Great Rainfall at Temperature of Rivers	101 135
Studi sulla comparazione degli Anemometri	37	Thermometer, Black Bulb in Vacuo, The	136, 149, 163, 182
Vero andamento diurno della Temperatura	37	Thunderstorm of February 2nd ...	10
Climatology of New Jersey	37	Thunderstorm at Boulogne, May 6th	64
Egeson's Weather System of Sunspot Causality; being original researches in Solar and Terrestrial Meteorology	55	Thunderstorms, The, of May and June	68
Untersuchungen ueber die tägliche Oscillation des Barometers	57	Torquay, Snowstorm at	26
A List of the most Remarkable Earthquakes in Great Britain and Ireland during the Christian Era	58	Trinidad Rainfall	122
Lehrbuch der Meteorologie für		Waterspouts 17, 75, 84, 106, 117,	136
		Weather, Forms of Snow as indicative of coming	27
		Weather Indicators, Rooks as	41
		Weather Predictions, The proposed Bermuda Halifax Cable: Its Usefulness for	64, 171
		Wet Time, A, in West Australia...	166
		Whirlwinds, Two Shropshire, August 21st	114

METEOROLOGICAL MAGAZINE.

CCLXXVII.]

FEBRUARY, 1889.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THREE DAYS ON THE TOP OF MONT BLANC.

(Abridged from *La Nature*, of September 10th, 1887).

It is somewhat late to refer to an expedition carried out in July 1887, but both as regards Meteorology and Physiology, it was of considerable importance.

Our readers know something (not perhaps as much as they should do) of the remarkable series of self-recording meteorological instruments invented and constructed by MM. Richard Frères, of Paris. M. J. Vallot, a member of the Alpine Club, conceived the bold idea of establishing three series of these self-recording instruments in proper screens, one at Chamounix (3,445 ft.), one at the Grands Mulets (10,007 ft.) and one on the summit of Mont Blanc (15,781 ft.), and he not only did this, but much more—as will subsequently appear.

We pass over all preliminaries, though they can neither have been few nor unimportant, and come to July 27th, 1887, when the Chamounix instruments were all in position under the care of M. H. Vallot, who had also a series of instruments for direct observation each hour. The two observers for the summit M. J. Vallot and M. F. M. Richard, (of the firm of Richard Frères) were ready, the baggage, tent, and instruments weighing nearly a quarter of a ton—all which had to be carried up to the Grands Mulets, and very nearly all of which had to be taken up to the summit; no fewer than 24 guides were therefore necessary—indeed, it was asserted at Chamounix that to take all the baggage to the top and to spend three days up there was impossible.

However, the party started at noon on July 27th, reached the Grands Mulets at 10 p.m., went to sleep at 11 p.m., rose on 28th at 3 a.m., and reached the Grand Plateau at 7 a.m., where they rested awhile, but finally reached the summit at 3 p.m. All the guides but two started immediately to return, leaving M.M. Vallot and Richard and the two guides on the summit with all the boxes and baggage deposited on the snow. M. Richard and the two guides began to put up the tent, but soon found themselves exhausted, the former as well as M. Vallot suffering from head-ache and exhaustion. Then

they melted some snow, and with the snow-water and a spirit lamp made some soup, and with boxes for pillows went to sleep. M. Vallot however, soon recovered, and began erecting the apparatus, but cold soon drove him into the tent, and everybody, though shivering with cold, went to sleep. About 1 a.m. M. Richard awoke, and finding that they might all be choked for want of ventilation, he decided on leaving a small opening, and lighting a lantern, supposing that the carbonic acid would cause it to go out before there was serious danger to life. The precaution was needless, as a strong wind arose, and at the same time ventilated the tent, and never froze the occupants, and well it might, for when daylight came they found that the minimum on the snow had been $2\frac{1}{2}$ degrees below zero Fahrenheit, i.e., $34\frac{1}{2}$ degrees below freezing.

On the morning of 29th, all four residents were in better health, but M. Richard and Payot (one of the guides) had violent headaches, their pulses beat as if they were in high fever, and the exertion so fatigued them that they had to go into the tent to sit and lie down. Hourly observations were made regularly all day, and synchronously with those at Chamounix, and they had also the variety of a visitor, Baron Munch, who, having come up from Chamounix, was naturally very much astonished to find an observatory and hot soup on the top of Mont Blanc. Night closed in as usual, and passed less painfully than the previous one.

The 30th was again wholly devoted to observations. The party had no appetite and took little except soup with cheese crumbed in it, and hot coffee. This day they had two visitors, one an English tourist, the other a jackdaw, which the guides said was a sign of fine weather. It did not prove so. About 2 p.m. clouds gathered in the valleys, then it began to thunder, and to blow hard that at 4 p.m. they were driven into the tent. The first intention was to start downwards, but much must have been left behind, they tightened the tent and heaped up snow to protect it. During the evening M. Vallot took diagrams of the pulses of all the party and made other physiological observations, which were especially valuable considering the time that all had been on the summit. Going out about 9 p.m., he found himself in an electric cloud, with faint St. Elmo's fire. The storm ceased about 2 a.m., and all slept quietly.

The 31st had been fixed for the return, the hourly observations were continued until 9 a.m., then the greater part of the apparatus was stowed in the tent, a last look was given to the self-recording instruments, and the party was ready to descend, but Payot was so unwell with head ache and fever, that at first it seemed as if a sled must be made for him, however he rallied, and finally at 7 p.m. returned safe to Chamounix, having been absent 103 hours, of which 68 had been spent on the summit.

The recording instruments at Chamounix and Grands Mulets were the usual ones constructed to run a week without touching, but those on the summit were made to run 15 days, as ascents and

not always possible even in summer. Subsequently when M. Vallot went up to wind the instruments and put on fresh papers, Madame Vallot went with him.

We have not yet seen any account of the records obtained; when we do, we shall have pleasure in bringing them to the notice of our readers. It is not every day that one can find a man like M. Vallot, willing to defray the cost, and to bear the hardships, of three nights on Mont Blanc.

SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE.

PRESIDENTIAL ADDRESS BY M. E. RENOU

GENTLEMEN,—The Meteorological Society of France has just elected me President for the year, I thank you heartily, you have rewarded my devotion to the science which we all love. It is the third time that I have had this honour; the first was in 1858, when our Society was still young, in fact it dates from 1853. In 1852, some eminent men joined in drawing up a circular proposing the formation of the Society and inviting members, of those who signed that invitation, one alone is still with us, M. d'Abbadie; of the 148 who responded to the invitation, 10 only remain.

I will not trace the history of the Society, that has been done by M. Berigny, but it will not be inappropriate to consider what was the state of meteorology then, what it is now, and what it ought to be.

Four years before our Society was organized, a small group of devoted men had collected observations and published four annual volumes which served as models for our own. At that date there were few stations, and owing to the absence of any instructions, and of any supervision the observations were not made under favourable conditions. The thermometers, seldom exact, were all exposed at windows, and therefore could give only erroneous results, the barometers scarcely ever accurate, contained air, and the attached thermometers had rarely been verified. The rain gauges were of all patterns, most of them on roofs, and only collecting part of the snow. The vanes, heavy and inaccurate. The state of the weather only vaguely stated, and no definition of fog, so that little could be gathered from the registers; no definition of what constituted a "rainy day," so that of two observers in the same town, one would report twice as many days as the other.

This is by no means an exaggerated sketch of the state of things 36 years since.

This state of things impressed me from the first, naturally disinclined to accept any thing which was not proved, simply because it always had been, and having a natural antipathy to "about," I devoted all my care to the improvement of observations, and I have demonstrated that meteorology is capable of the same precision as other sciences.

Soon after our Society was founded, weather forecasting attracted

much attention, and with that object efforts were made to cover France with a multitude of stations at a cost little exceeding that of the instruments, and as 1-1000ths of an inch of mercury, and 1-10ths of a degree of temperature are needless for weather forecasting, precision was not aimed at, but it was hoped that the observations would gradually improve, and that eventually accurate climatological data would be obtained.

This was a great mistake. I have always held that nothing would be learned this way, and the result has confirmed my opinion.

Weather forecasting itself has not achieved a very great success, but this is not from want of accuracy in the observations utilized, but rather from the limited area whence reports are received, and deficient rapidity in the despatches. The heads of the services in each country should be in direct and prompt communication, and then bad weather could always be announced. But we ought first to have records from Central Africa, Senegal, the Azores, and America. It will be long before we obtain these valuable helps.

As regards precise, complete, accurate meteorology from 20 to 25 meteorological observatories are needed in France. Then we can utilize volunteers, and establish a great number of secondary stations for the study of the rainfall, storms, snow-storms, inundations, &c., it is also necessary to have mountain stations among which the chief should be Mont Blanc. Nothing is easier than to have at the top of such a mountain an observatory of which the records should be automatically transmitted to the base, and there recorded. It is solely a question of money.

I have often been asked why frequent, and hourly observations are required. They enable us to solve all kinds of questions. They enable comparisons to be made with stations at which observations can be made only three or four times a day, that is especially needed in comparisons with countries far E., or far W., of France. Hourly readings coupled with the sheets from self-recording instruments give us all the details of meteorological phenomena. Is it not painful to see in the records of the Observatory, that many important phenomena are not even mentioned, because they did not occur at the regular hour for observations. In legal cases one of the first things asked a witness is often, "What was the weather?" If our records are vague and incomplete, how can we state what it was at a certain hour on a given day. I have often had to give evidence of this kind.

If in France, proper meteorological arrangements, especially as to thermometer stands have been adopted, it is not so in other countries where the best pattern of stand is still being discussed, whereas in France it is settled. We hope that the Congress to be held in Paris this summer will have the advantage of bringing foreign observers to see us; they will be able to see how the Observatory of Parc St. Maur is organized, and can ascertain for themselves how far we have advanced in the determination of all the phenomena which are dealt with by meteorologists.

REVIEWS.

Results of Meteorological Observations made in New South Wales during 1886, under the direction of H. C. RUSSELL, B.A., F.R.S., Government Astronomer. Charles Potter, Sydney, 1888. 8vo., 186+192 pages, and 15 diagrams.

Results of Rain, River, and Evaporation Observations made in New South Wales during 1887. By H. C. RUSSELL, B.A., F.R.S., 8vo., 100 pages and 3 large maps.

SERIAL publications on Meteorology are so numerous, that it is impossible for us to notice a tithe of them; the only thing to do is to take sometimes one, sometimes another, and so keep our readers acquainted with what is going on.

There are few colonies where better work is being done than in New South Wales. We are not sure that we may not take the steady growth of the meteorological system there, and the very large amount of accurate work published by Mr. Russell, as evidence of the goodness of the climate. It may be that the Colony is wise enough to give him a good staff of assistants; and then good training and a good system will produce a good output of work, provided the head knows what is to be done, and does not waste the mental power placed at his disposal. But there is more than quantity and quality in Mr. Russell's work, there is originality and solidarity, and it seems to us that we can trace in his work the difference between sunny Sydney and, shall we say, foggy London.

It is some years since we last noticed these reports, and the two now before us are substantial evidence of the development of the organization throughout the Colony, for Mr. Russell has now 866 stations, and (most wonderful of all, for it shows how populous the Colony is becoming,) there is only *one square degree* (i.e., 29° to 30° S., and 142° to 143° E.,) *without a rain gauge station*. This is progress indeed, and if we do not secure some fresh observers in Sutherland, we shall have the New South Wales people beating us.

Mr. Russell has for many years given much attention to evaporation, and is now spreading observations of this important element, not broadcast over the Colony, but at typical stations.

It is rather curious that each of three directors of Sydney Observatory designed an evaporator.

Mr. Scott's was the first; a cylindrical glass standing on the ground, about 8 inches high and 8 inches in diameter, containing usually about 6 inches of water. Read by a vernier and ivory point.

Mr. Smalley followed with a tin vessel painted white, standing on the ground, 1 foot high, 8 inches in diameter, and usually containing about 8 inches of water. Amount of evaporation determined by weighing, vessel and contents each day.

Lastly came Mr. Russell's of galvanized iron, 2 ft. 6 in. deep, 4 ft. in diameter, sunk 2 ft. 4 in. in the ground. Read by float and finely divided scale.

It is easy to see that the water in both Scott's and Smalley's would heat far too much if, as we suppose, they were exposed to sun and air. In fact, this seems proved in two ways, first by the very much larger amount which they indicated as compared with Russell's, and secondly, by the fact that their excess over Russell's was roughly proportional to temperature. The nine years 1871-79 give the following values :—

	Evaporation.	
	Inches.	Ratio.
Scott	49·22	156
Smalley	54·83	173
Russell	31·69	100

And this helps us out of a puzzle of which we could not at first guess the solution. At several of the second order stations the amount of evaporation is given, and is followed by the following note, "Evaporation from a bucket, if it is reduced 35 per cent., it equals that from a tank." Now "a bucket" is a bucket all the world over, but a tank—well the name is applied to bodies of water of from 100 to 100,000 gallons or more. Moreover, "a bucket" implies a handle and sloping sides, and is altogether somewhat unscientific. Yet after all the note put into scientific phraseology should, we believe, be, "Evaporation by Smalley's evaporator, if it is reduced 35 per cent., it equals that from Russell's." If we take our nine year means as above, Smalley 54·83 in., Russell 31·69 in., and apply this rule to the value given by Smalley's instrument.

$$\begin{array}{r} \text{then } 54\cdot83 \\ \left(\frac{54\cdot83}{100} \times 35\right) = - \frac{19\cdot19}{34\cdot64} \end{array}$$

the 35 per cent. would therefore be rather too small, 43 per cent would be the value for our nine years, but doubtless Mr. Russell has good grounds for adopting 35.

It is well known to be wrong to speak disrespectfully of the Equator; we certainly have no reverence for Smalley's evaporator, but it does seem rather hard to call it "a bucket," however much it may resemble one.

Another subject to which Mr. Russell gives special attention is that of underground temperature. The mean values for 1866 were—

Shade temp.	1 in. deep.	2 ft. 6 in. deep.	5 feet deep.	10 feet deep.	19 ft. deep.
63·5	62·7	64·3	64·1	64·0	65·8

As regards this last value, we regret that (we believe) the system of earth thermometers adopted at Sydney does not admit of the thermometers being withdrawn for verification, because we believe that in December, 1886, this thermometer was quite $1\frac{1}{2}$ degrees too high. We have not the volume for 1881, but we think that the value for that year should be $62^{\circ}6$; if so, it appears that for some

unknown reason that thermometer, which remained steady from 1870 to 1881, has since then risen $0^{\circ}\cdot4$ per annum. We do not want to load this notice with figures, and therefore do not insert the data which have led to this conclusion, being quite sure that it is sufficient to call Mr. Russell's attention to it. The change may be real, may be due to some drainage scheme, or railway cutting for aught we can tell, but there is certainly some change going on at 19 ft. which is not felt at 5 ft. or at 10 ft.

One more grumble. Mr. Russell's work is so good that there is no fear of our conveying any false impression as to our estimate of it, and we can therefore indulge in grumbles without any risk of being misunderstood. But why, oh why, does he print such a remark as this, "A shock of earthquake lasting 2'." Mr. Russell is one of the first astronomers of the day, and yet he prints 2" (for two seconds of time) as if it were either 2 inches, or 2 seconds of arc. He might evidently, with truth, reply that the word "lasting" proves that "must be indicative of time, and not of either arc or length; but in all probability he will agree with us that while it is bad to use the same symbol for seconds of arc and for inches, it is needless to use it also for time where "s" is the recognized symbol.

And now having found all the fault that we can, let us conclude by congratulating Mr. Russell on the excellency of his organization, the Colony on having so able a director, and the world on the mass of valuable information gradually being stored in that distant Colony.

Ueber eine nahezu 26-tägige Periodicität der Gewittererscheinungen.
VON W. VON BEZOLD. [Excerpt Sitzungsab. der K. Preussischen Akad. d. Wis.]. 1888. 8vo. 10 pages.

Prof. von Bezold points out that the magnetism of the earth has a periodicity of about 26 days, corresponding therefore closely with that of the rotation of the sun on its axis.

Considering the intimate relation which ~~exists~~ between magnetism and electricity, Prof. von Bezold has ~~tabulated~~ the returns of thunderstorms in Bavaria and in Wurtemberg for eight and seven consecutive years respectively, in order to ~~see~~ if these values showed any analogous periodicity. There is no doubt that they do, and it is therefore obviously desirable that a similar investigation should be made in other parts of the world.

THE FOG, AND GAS CONSUMPTION.

THE *Gas World* gives some figures regarding the quantity of gas sent out by the Gas Light and Coke Company during the recent foggy weather. On Monday December 31st, when the fog was very bad, the output reached the highest point ever recorded, viz.; 105,046,000 c. ft. On the corresponding day of last year the output was only 79,978,000 c. ft. The increase is thus at the rate of 23·86 per cent. In the course of the week ended the 7th inst., the output was 627,317,000 c. ft., as against 512,943,000 c. ft. for the corresponding week of 1888, or an increase of 18·23 per cent. The Gas Light and Coke Company has always been prepared to meet a demand for gas, ranging from 50,000,000 to 105,000,000 c. ft. per day. The general public accept the friendly aid of the gas lamps on a foggy day, but they never give a thought to the enormous labour and expense involved in the production of the gas required. They take it as a matter of course, and would no doubt make a great outcry were it withdrawn even for a minute.

Yes, quite true from the manufacturer's point of view. But there are two sides to most things. The Company up to the above date charged 2s. 9d. per 1,000 cubic feet, therefore on December 31st, they charged £14,443 16s. 0d. (about 360,000 francs) for the gas they supplied, and this was £3,446 17s. 0d., more than on the corresponding day of the previous year. Allowing the odd £446 17s. 0d., for natural growth, we have an extra payment to one gas company for one day's fog of £3,000. Add to that payments to other companies; extra electric lighting, lamps, &c., the cost of damaged goods, damaged vehicles, damaged health, and surely for London alone we may put the cost of that one day's fog, at from £6,000 to 10,000. And though that was the worst, we have had quite twenty bad ones—take each of these as only half as bad, and we get a total damage of from £60,000 to £100,000, irrespective of the enormous amount of money taken out of the country by those who rush to the Riviera to escape them, and the thousands kept out of the country by those who do not care to visit us during our foggy season, and we are sure that £120,000 is the minimum damage. And yet not a sixpence is forthcoming to try the experiment mentioned in our last. We are not electricians, and do not for a moment assert that anything can be done—but it does seem strange that with such vast amounts at stake, we drift on without even trying if anything can be done. Suppose £100 or £1,000 was "thrown away" in experiments what would it represent. Six hours fog—ED. M.M.]

ROYAL METEOROLOGICAL SOCIETY.

THE anniversary meeting was held on January 15th, at the Institution of Civil Engineers, 25, Great George Street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair. Mr. Maxwell Hall, Mr. G. T. Livesey, M.Inst.C.E., Mr. E. W. Priestley, B.Sc., Mr. J. Radcliffe, and Rev. J. R. Stratton, were elected Fellows of the Society.

The Report of the Council showed that a large amount of work had been done during the past year, and considerable progress made in the investigation of one of the most interesting and hitherto somewhat neglected branches of meteorology—viz., thunderstorms. Forty-nine new Fellows were elected last year, the total number on the books now being 535.

After the Report had been adopted, the President delivered an address on "Fogs," which he illustrated by a number of interesting lantern slides. He considered fogs and clouds as one and the same, and that a cloud is a fog when entered into, and a fog seen from a distance, suspended in the air, becomes a cloud. After describing the various kinds of fog—*e.g.*, river, sea, Newfoundland, radiation, town, &c., fogs—Dr. Marcet referred to London fogs. Dr. Tyndall has accounted for them by assuming each particle of condensed vapour to be covered by coal smoke. These fogs usually accompany a high barometer, and are frequently dry in their character. It is a well-known fact that cold air on the tops of hills being heavier than the air below, slides down the slopes, so that the lower parts of hill sides are actually colder than the plains at some distance from the hills. Now London, in the Thames valley, may be regarded as surrounded by hills—to the north, Highgate, Hampstead, and Harrow; in a westerly direction, Putney and Wimbledon; and in a more southerly direction, Clapham and Sydenham. The air is colder on these hills than in London with its millions of inhabitants, its coal fires and factories, hence it is heavier and will have a great tendency to slide down towards the town and the river. Should the air in town be on the point of saturation, and the cold air from above saturated with vapour, it is obvious that the increased cold from above will produce a precipitation of moisture, and it will come to pass that a fog is produced. If the hill tops be not only colder than the air below, but enveloped in a fog, it stands to reason that the fog below will be all the denser, and especially in the neighbourhood of water, such as the River Thames and the ornamental waters in the parks.

The Officers and Council for the ensuing year were then elected, and the meeting adjourned.

THUNDERSTORM ON FEBRUARY 2ND.

To the Editor of the Meteorological Magazine.

SIR,—On the 2nd inst., at 7.30 p.m., there occurred at this place a thunderstorm of short duration. There were three very bright flashes of lightning, with intervals of about one minute between consecutive flashes, which were followed in each case one second later by a loud clap of thunder. It may be noted that after a long interval of solar inactivity, sun spots, although very minute, have been visible since the beginning of this month.

Yours obediently,
J. PARNELL.

*Hadham House, Upper Clapton, E.
February 5th, 1889.*

GLOBULAR LIGHTNING.

To the Editor of the Electrician.

SIR,—This evening at 7.35 p.m. a fireball about two metres in diameter fell in the direction of Stamford-hill, N. At the same time a fearful explosion took place, lasting some two seconds, and the globe of fire seemed to split into four quarters, showing a bluish fiery light. The explosion was unlike thunder, and was more like a detonation of explosives. A snowstorm of two minutes' duration ensued, leaving $1\frac{1}{2}$ in. of snow on the ground; after which the atmosphere became splendidly clear. It would be interesting to know if this phenomenon has been observed by others in this neighbourhood, and under what conditions. The wind was W.N.W., sky cloudy, and the thermometer stood at 38° F.—Yours, &c.,

ERNST FAHRIG.

Listria Park, Stamford-hill, Feb. 2.

RAINFALL AT HELIGOLAND.

Dr. Hellman recently worked up the observations on the rainfall of Heligoland, and obtained the mean annual rainfall of 72.50 inches, far exceeding the quantity observed at any of the stations on the west coast of Sleswick or the mouth of the Elbe. He explains this excessive rainfall by the circumstance that the steep coast, rising almost perpendicularly to the height of 164 feet above the level of the sea, forced the moist sea winds suddenly upwards, and so caused them to condense very rapidly.—*Athenæum*.

THE OLD BAROMETER IN SALISBURY CATHEDRAL.

Some years since a discussion arose as to when and why the word "Change" on barometers was put against $29\frac{1}{2}$ inches instead of against 30, which is much nearer the real mean pressure. We do not remember that any satisfactory reply was given.

Last autumn we saw in the vestry of Salisbury Cathedral an extremely old barometer—we do not know either the maker or the date—but we will revert to these after giving the barometric scale, which seems designed on the one side for mild, on the other for severe, weather.

Fair if Mercury Rises.		Foul if Mercury Falls.	
Very Dry.....	31	Hard Frost	
Set Fair	30·5	Set Frost	
Fair	30	Frost	
Change	29·5	able	
Rain	29	Snow	
Much Rain	28·5	Much Snow	
Stormy	28	weather	

It is provided with an attached thermometer, and this gives us a rough guide as to date. The scale is a curious one; it reads *downwards* from a point called "Extreme hot." But we give the lettering :—

Extreme hot	0
Sultry	15
Hot	25
Warm air.....	35
Temperate air.....	45
Cold air	55
Frost.....	65
Hard frost	75
Extreme cold	90

An Immisch thermometer placed beside it read 52° when the above thermometer was at 36° .

Now this scale is the one first used in this country, being "made (and commonly very carelessly made) after the standard one kept in the Royal Society,"* and as Fahrenheit's scale was, we believe, in general use by 1730, it seems probable that this Salisbury barometer is at least 160 years, and (considering the history of barometers) not more than 190 years old.

This would carry the placing of the word "Change" opposite $29\frac{1}{2}$ inches back to between 1700 and 1730. Can anyone complete the inquiry?

* Martine, G., M.D. "Essays on the Construction and Graduation of Thermometers." 2nd Edition. Edinburgh, 1772, page 45.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JULY, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0.100	°	°	inches		0.10
England, London	72·7	19	42·8	11	67·1	52·3	52·4	82	120·2	41·6	4·91	26	7·7
Malta	102·8	10	63·6	4	89·0	70·8	65·5	65	154·7	56·0	·00	...	0·7
Cape of Good Hope. ...	67·0	25	35·5	19	59·6	45·7	...	...	...	...	3·77	12	5·4
Mauritius	77·0	7	56·7	18	74·7	63·5	59·4	74	123·0	47·3	1·50	19	4·7
Calcutta	92·5	16a	75·2	31	87·9	78·3	77·8	83	158·5	74·3	12·25	24	9·1
Bombay	87·5	12	73·3	14	84·6	77·8	76·8	86	142·0	70·9	22·47	28	9·5
Ceylon, Colombo	87·4	17	75·6	25	85·9	77·7	72·0	76	143·0	72·2	·98	6	5·8
Melbourne	64·2	1	28·3	27	55·4	41·8	41·2	76	113·4	20·9	1·51	15	6·2
Adelaide	62·3	6	39·7	21	58·2	46·8	46·1	79	119·4	33·5	4·04	26	6·6
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	61·5	25	40·0	19, 30	57·4	46·3	45·4	79	115·0	29·0	3·85	20	6·6
Jamaica, Kingston	94·6	28	70·8	24	90·9	74·2	74·3	73	...	...	1·88	...	...
Barbados	86·0	14b	70·0	2, 18c	83·0	73·0	74·0	85	...	...	...	...	6·0
Toronto	87·7	4	47·3	13	76·6	55·7	53·9	65	...	40·2	·86	9	5·0
New Brunswick, Fredericton	85·7	5	42·0	2	75·7	52·4	54·7	68	...	...	2·12	16	6·2
Manitoba, Winnipeg ...	91·0	28	43·3	7	78·2	53·4	56·2	73	...	...	3·78	13	4·1
British Columbia, Victoria	85·0	17	37·0	7	70·7	46·7	...	...	...	...	·84	5	..

a And 18. b And 15. c And 19, 20.

REMARKS, JULY, 1888.

MALTA.—Mean temp. 78·7; mean hourly velocity of wind 7·9 miles. Sea temp rose from 76°·0 to 82°·8. Temp. in shade above 100° on 3 days. J. SCOLES.

Mauritius.—Mean temp. of air 0°·1 below, mean dew point 0°·1 above, and B ·88 in. below, their respective averages. Mean hourly velocity of wind 11·0 miles, or 0·6 below average; extremes 29·0 miles on 26th and 2·4 on 25th. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·8 above average; dew point 0°·2, humidity 4, mean amount of cloud 0·1, pressure ·092 in., and B ·22 in. below average. Prevailing winds N. and N.W.; strong on 12 days. Heavy dew on 7 days. Ice on 2 days. Dense fog on morning of 6th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure ·054 below the average of 31 years. Mean temp. 0°·8 and rainfall 1·50 in. above average. C. TODD.

Auckland.—Finer and more moderate than usual for July, with very little wind. Rainfall 1·00 in. below the average of 21 years. Mean temp. and pressure close to the average. T. F. CHEESEMAN.

BARBADOS.—Mean temp. (77°·2), 0°·5 above the average. Mean hourly velocity of wind 2 miles below the 15 years' average. Rainfall a trifle above the average. Evaporation 15 per cent. below the average. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL,
 JANUARY, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain. in.	Div.	STATION.	Total Rain. in.
II.	Dorking, Abinger	1.52	XI.	Castle Malgwyn	2.14
"	Margate, Birchington...	.74	"	Rhayader, Nantgwillt..	2.65
"	Littlehampton	.95	"	Carno, Tybrith ...	2.18
"	Hailsham	1.14	"	Corwen, Rhug	1.53
"	Ryde, Thornbrough	1.13	"	Port Madoc	2.64
"	Alton, Ashdell	1.27	"	I. of Man, Douglas ...	2.46
III.	Oxford, Magdalen Col...	.66	XII.	Stoneykirk, Ardwell Ho.	2.68
"	Banbury, Bloxham	.64	"	New Galloway, Glenlee	4.55
"	Northampton	.78	"	Melrose, Abbey Gate...	.66
"	Cambridge, Beech Ho...	.71	XIII.	N. Esk Res. [Penicuik]	1.30
"	Wisbech, Bank House...	.91	XIV.	Ballantrae, Glendrishaig	3.96
IV.	Southend	1.04	"	Glasgow, Queen's Park.	2.04
"	Harlow, Sheering ...	.61	XV.	Islay, Gruinart School..	6.21
"	Rendlesham Hall	.77	XVI.	Dollar	2.54
"	Diss	.91	"	St. Andrews, PilmourCot	1.03
"	Swaffham	.74	"	Balquhider, Stronvar...	7.30
V.	Salisbury, Alderbury...	.71	"	Dunkeld, Inver Braan...	2.46
"	Warminster	.72	"	Dalnaspidal H.R.S. ...	4.84
"	Bishop's Cannings	.84	XVII.	Keith H.R.S.	1.14
"	Ashburton, Holne Vic...	2.49	"	Forres H.R.S.	.51
"	Hatherleigh, Winsford.	2.81	XVIII.	Strome Ferry H.R.S....	5.85
"	Lynmouth, Glenthorne.	1.97	"	Fearn, Lower Pitkerrie.	.81
"	Probus, Lamellyn	2.63	"	Loch Shiel, Glenaladale	12.83
"	Launceston, S. Petherwin	1.94	"	N. Uist, Loch Maddy ...	4.73
"	Wincanton, Stowell Rec.	.90	"	Invergarry	6.49
"	Taunton, Lydeard Ho...	.86	"	Loch Ness, Drumnadrochit	1.94
"	Wells, Westbury	.54	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	.84	"	Forsnard H.R.S.	...
"	Ross	.84	"	Watten H.R.S.	1.45
"	Wem, Clive Vicarage ...	.39	XX.	Dunmanway, Coolkelure	7.12
"	Cheadle, The Heath Ho.	.97	"	Fermoy, Gas Works ...	2.94
"	Worcester, Diglis Lock	.56	"	Tipperary, Henry Street	3.03
"	Coventry, Coundon	1.06	"	Limerick, Kilcornan ...	2.46
VII.	Ketton Hall [Stamford]	1.39	"	Milton Malbay	4.27
"	Grantham, Stainby	1.56	XXI.	Gorey, Courtown House	2.34
"	Horncastle, Bucknall ...	1.21	"	Navan, Balrath	3.21
"	Mansfield, St. John's St.	1.32	"	Mullingar, Belvedere...	1.82
VIII.	Neston, Hinderton	.55	"	Athlone, Twyford	2.48
"	Knutsford, Heathside ...	1.19	"	Longford, Currygrane...	3.06
"	Lancaster, South Road.	2.49	XXII.	Galway, Queen's Coll...	3.52
"	Broughton-in-Furness ...	3.39	"	Clifden, Kylesmore ...	8.10
IX.	Wakefield Prison	1.22	"	Crossmolina, Enniscoe...	4.36
"	Ripon, Mickley	.98	"	Collooney, Markree Obs.	3.40
"	Scarborough, West Bank	1.15	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	.67	XXIII.	Warrenpoint	4.53
"	Middleton, Mickleton...	1.32	"	Seaford	2.57
X.	Haltwhistle, Unthank...	1.29	"	Belfast, New Barnsley...	3.39
"	Shap, Copy Hill	3.13	"	Bushmills, Dundarave...	2.78
XI.	Llanfrechfa Grange	1.63	"	Stewartstown	2.64
"	Llandovery	3.05	"	Buncrana	2.79

JANUARY, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Nights below 32°.		
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Days on which -01 or more fell.	Max.		Min.					
				Dpth.	Date.		Deg.	Date.	Deg.	Date.				
		Inches.	Inches.	in.									In shade.	On grass.
I.	London (Camden Square) ...	·81	— 1·54	·19	12	10	53·1	31	22·0	7	11	22		
II.	Maidstone (Hunton Court)...	·93	— 1·64	·38	9	8	...	...	...	...	...	...		
III.	Strathfield Turgiss	·80	— 1·75	·40	9	11	50·1	18	19·0	6	20	24		
III.	Hitchin	·92	— 1·30	·28	9	14	52·0	31	19·0	5	12	...		
IV.	Winslow (Addington)	·99	— 1·56	·30	9	12	52·0	31	16·0	6	19	24		
IV.	Bury St. Edmunds (Culford) ..	·60	— 1·24	·35	13	...	46·0	25	12·0	6	...	25		
V.	Norwich (Cossey)	·78	— ·92	·20	11	10	...	...	...	...	...	10 18		
V.	Weymouth (Langton Herring) ..	·68	...	·26	9	11	51·0	31	30·0	2, 6	10	...		
"	Barnstaple	1·19	— 3·07	·30	9	8	53·0	19a	24·0	4	...	...		
"	Bodmin	2·89	— 3·62	·80	11	15	50·0	29	30·0	3, 4, 6	7 15	...		
VI.	Stroud (Upfield)	·80	— 2·19	·25	9	15	52·0	29b	22·0	3	17	...		
"	Church Stretton (Woolstaston) ..	·66	— 2·77	·18	9	16	52·5	18c	20·0	6	15	24		
"	Tenbury (Orleton)	·59	— 2·40	·24	8	11	54·0	18c	19·3	4	16	19		
VII.	Leicester (Barkby)	1·42	— ·58	·51	9	15	54·0	31	19·0	3	21	26		
"	Boston	·97	— ·75	·24	10	10	50·0	28	15·0	6	18	...		
"	Hesley Hall [Tickhill]	1·58	...	·70	9	13	54·0	31	16·0	6	16	...		
VIII.	Manchester (Ardwick)	1·22	— 2·02	·32	31	11	56·0	18c	30·0	1	5	...		
IX.	Wetherby (Ribston Hall) ...	·99	— 1·23	·34	10	10	...	...	...	...	...	...		
"	Skipton (Arncliffe)	3·25	— 3·68	1·18	29	16	...	...	...	...	...	...		
"	Hull (People's Park)	1·38	— ·53	·69	9	18	...	...	...	...	...	...		
X.	North Shields	1·20	— ·64	·35	9	13	56·5	31	26·0	27	13	16		
XI.	Borrowdale (Seathwaite)	12·36	— 6·39	3·10	29	16	...	...	...	...	...	...		
XI.	Cardiff (Ely)	1·89	— 2·82	·73	9	10	...	...	...	...	...	...		
"	Haverfordwest	2·65	— 3·62	·49	28	21	51·4	29	23·6	2	12	20		
"	Plinlimmon (Cwmsymlog) ...	3·35	...	1·03	9	11	...	...	...	...	...	...		
"	Llandudno	1·21	— 1·75	·39	9	15	53·9	29	31·2	7, 27	2	...		
XII.	Cargen [Dumfries]	2·62	— 3·49	·64	28	14	53·6	31	22·8	27	8	...		
XIV.	Jedburgh (Sunnyside)	·54	— 1·51	·13	9	11	52·0	18c	23·0	27	13	...		
XV.	Old Cumnock	3·14	— 1·50	·59	28	14	53·0	18	20·0	26	10	...		
"	Lochgilthead (Kilmory)	8·47	+ ·60	1·24	8	21	...	...	...	...	...	...		
"	Oban (Craigvarren)	5·87	...	1·08	17	23	53·6	17	29·6	27	3	...		
"	Mull (Quinish)	7·68	...	1·17	15	21	...	...	...	...	...	...		
XVI.	Loch Leven Sluices	1·80	— 2·02	·50	18	8	...	...	...	...	...	...		
XVII.	Dundee (Eastern Necropolis) ..	1·20	— 1·25	·40	8	11	57·6	31	23·7	2	11	...		
XVII.	Braemar	1·68	— 1·10	·50	8	18	53·3	18	19·3	2	12	28		
"	Aberdeen (Cranford)	...	...	...	...	...	...	...	...	...	...	...		
XVIII.	Lochbroom	3·45	...	·69	18	18	...	...	...	...	...	...		
"	Culloden	2·80	— 1·49	...	...	...	55·0	18	30·0	2e	9	21		
XIX.	Dunrobin	1·53	...	·40	9	9	58·0	18	28·0	2	10	...		
"	S. Ronaldsay (Roeberry)	2·37	— ·47	·34	15	22	...	...	...	...	...	...		
XX.	Cork (Blackrock)	3·40	— 2·62	1·17	15	12	61·0	31	26·0	2	8	...		
"	Dromore Castle	7·28	...	1·36	15	14	54·0	30	28·0	15	...	...		
"	Waterford (Brook Lodge) ...	2·51	...	·86	11	13	58·0	31	23·0	3	6	...		
"	O'Briensbridge (Ross)	3·17	...	·67	11	17	54·0	31	25·0	3	...	11		
XXI.	Carlow (Browne's Hill)	2·36	— 1·26	·58	11	22	...	...	...	...	...	...		
"	Dublin (Fitz William Square) ..	2·21	— ·05	1·22	11	16	56·2	18	27·1	3	3	16		
XXII.	Ballinasloe	2·94	— 1·42	·74	11	23	51·0	31	21·0	2	13	...		
XXIII.	Waringstown	1·97	— 1·44	·47	8	20	54·0	17d	24·0	2, 26	13	18		
"	Londonderry (Creggan Res.) ..	3·27	...	·48	16	25	...	...	...	...	...	...		
"	Omagh (Edenfel)	3·37	— ·40	·75	11	22	53·0	17	25·0	1	8	12		

α And 29, 30. b And 30. c And 31. d And 18, 31. e And 7, 11, 27.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JANUARY, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The greater part of the month was mild and free from storms of any serious kind. Agricultural matters were in a very satisfactory condition, and owners of breeding flocks have good reason, so far, to congratulate themselves upon such a favourable season.

WINSLOW, ADDINGTON.—From the first until the 8th very sharp frost prevailed, the max. temp. on 5th and 6th being 24° and 25° respectively. Fog was very dense on several days and the trees were beautifully covered with rime. During the remainder of the month there were frequent slight frosts, but none severe. The last day of the month was very mild, max. temp. 52°.

WEYMOUTH, LANGTON HERRING.—On the whole a very fine month; there were a few foggy days and on several a little rain fell, but the total was 2·46 in. below the average. Mean temp. 38°·4, 0°·9 below the average of 17 years. The 5th, 11th, 13th, 14th, and 15th were more or less foggy, but on no day was the fog dense. The month was very calm, no storm occurring.

BODMIN.—A mild month, with high pressure. Mean temp. 39°·5.

UPFIELD, STROUD.—Fog on four days, with an unusual amount of rime. S.W. gale on 29th.

WOOLSTASTON.—An open, spring-like month, with constant slight frosts at night; gale on the 28th. Mean temp. 37°·5.

ORLETON.—A thick fog prevailed for the first seven days, during which time the sun was only visible for a few hours on the mornings of 2nd and 4th. A great rime commenced on the 3rd and lasted until the 8th. The remainder of the month was generally cloudy with occasional frosty nights. The temp. was very variable, but for the whole month the mean was only a trifle less than the average of 28 years. The bar. on the 3rd stood at 30·50, but on the 9th it fell to 29·12, accompanied by violent wind; afterwards it was generally very high and steady, although the sky was very changeable. The R was about two inches below the average and was smaller during the last 58 years only in 1855, 1858, and 1880. No snow fell during the month.

BARKBY.—A lovely rime upwards of an inch deep was on all the trees from 3rd to 7th, looking all the more decorative because of the contrast of the green grass; it was on the S.W. side of the branches, facing the wind. Five days' skating. Mean temp. 35°·1.

MANCHESTER.—A very mild month, with comparatively high temp. There was very little frost and no snow. Fog on the first six days.

HULL.—Fog and hoar frost prevailed during the early part of the month, but afterwards the weather was generally mild and fine, but cloudy.

WALES.

HAVERFORDWEST.—The month commenced densely foggy, with severe frost; the weather changed on the 7th, when R fell, and cold, rainy, foggy weather prevailed, with low night temp., to the end of the month. Mean temp. about the average of 25 years. Very high bar. during the first week.

SCOTLAND.

CARGEN.—The weather during the month was very changeable, and the fluctuations of pressure and temp. were on two or three occasions great and sudden. Frost never continued more than two days at a time. Mean temp. 1°·5 above the average.

JEDBURGH.—The temp. generally was high, but very variable; vegetation progressed much, especially spring flowers; a blackbird's nest with four eggs was found towards the close; agricultural work went on without intermission. The month is said by old people to be the mildest in their recollection.

OBAN, CRAIGVARRÉN.—An open warm month, with equable temp., growth continuing throughout; at the close only it became stormy; neither H nor S.

BRAEMAR.—A month of excellent and spring-like weather. Blackbirds heard singing on 25th.

LOCHBROOM.—Considering that January is generally the stormiest month of the year, this has been a wonderful one for openness and mildness; only on the 25th did it snow a little on the low ground, and soon melted. It was rather boisterous after the 23rd, but generally so warm that the bees were playing about their hives, and snowdrops and daisies were in full flower.

INVERNESS, CULLODEN.—The month was remarkable for the absence of R, and for high temp. Vegetation advancing rapidly.

ROEBERRY.—From the 1st up till the 18th the weather was settled and mild, but the latter part of the month was very rough and unsettled. Heavy gale from W. to N.W. on 18th.

IRELAND.

CORK.—Dull and foggy, with some frost, during the first two weeks, the remainder mostly fine and mild for the season.

DROMORE.—Weather very mild and open.

WATERFORD.—E greatly below the average. The month generally was very mild, mean temp. $40^{\circ}4$.

ROSS.—No severe weather, very mild from 17th to the close, the mean temp. for that fortnight being 44° .

DUBLIN.—Open, but changeable. The mean temp., $42^{\circ}4$, was $1^{\circ}1$ above the average. The atmosphere was foggy on each of the first six days, and also on 22nd. High winds on eight days, reaching the force of a gale on two days, 11th and 18th. H fell on 9th and 11th, and S and sleet on 11th. Temp. exceeded 50° on eight days, compared with ten days in December, 1888, while it fell to or below 32° on only three nights, compared with five in December. The last five days of the month were chiefly mild, changeable and cloudy, and E fell frequently, although not in large quantities.

EDENFEL, OMAGH.—The month commenced with clear, pleasant, frosty weather, which on the 5th gave place to a continuance of the mild, and generally wet weather that has been so far characteristic of the winter. The ground was not once white with S.

LUNAR RAINBOW.

To the Editor of the Meteorological Magazine.

SIR,—Last night, November 19th, we were favoured with a remarkably fine lunar rainbow here in the W.N.W. When I first saw the bow the arc was perfect without any break; the brightest portion was towards the north, *i.e.*, for about 70° from the northern extremity, this part having the faintest blue tinge, the remainder being a misty white. A friend, with whom I had been conversing about a lunar rainbow some days previously, called at my house to tell me of it at 8 o'clock. I went out immediately, and watched it until its disappearance at 8h. 11m. The moon, full the previous day, rose at at 5h. 1m., and was therefore well above the horizon, and shining very brightly through the gaps in the heavy clouds. My friend assured me that he had seen the bow at intervals for fully an hour.

Yours truly,

WALTER E. STEWART.

Croft-on-Tees, Darlington, November 20th, 1888.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXVIII.]

MARCH, 1889.

PRICE FOURPENCE,
[or 5s. per ann. post free.]

A COLD PERIOD.

Two able men have recently and almost simultaneously drawn attention to a long period of cold which has prevailed over some parts of Europe.

M. Lancaster, of Brussels, in his article on the climate of Belgium during 1888, in the *Annuaire de l'Observatoire Royal de Bruxelles* for 1889, begins with the following remarks :—

“The year 1888, like its predecessor 1887, has been very cold. It has even been colder than 1887.

“For nearly four years the temperature has been almost constantly below the average. The persistency of this extraordinary state of things is a fact without precedent.

“From January, 1885, to November, 1888, there have been 35 months, out of 47, in which the temperature has been below the average.

“In 1888 every month up to November was below the average, the deficiency in February being as much as $8^{\circ}3$.

“Only three years (since the establishment of the Observatory in 1833) have been colder than 1888, viz., 1879, $47^{\circ}2$; 1845, $47^{\circ}9$; 1855, $47^{\circ}9$; 1888, $48^{\circ}0$. The mean for 1887 was $48^{\circ}4$, therefore these two years may be regarded as amongst the coldest of the century.”

M. Flammarion's note was, we believe, originally published in the *Petit Journal*; we, however, have only the note as quoted in *Le Figaro*, which is to the following effect :—

“As the result of comparing meteorological observations made in France and abroad, M. Camille Flammarion states that during four years the temperature of our climates has fallen considerably. It is therefore certain that we are passing through a period of cooling. Almost all the months are below their average, and the fall in February and March is striking. The fall on the average of the whole year is from $2^{\circ}7$ to $3^{\circ}6$ for France and Belgium, so that, for example, at Paris, instead of $51^{\circ}4$ it has been $48^{\circ}0$, and at Brussels instead of $50^{\circ}5$ it has been $48^{\circ}0$.”

In the foregoing extracts the old-fashioned year, beginning with December and ending with November, has, we believe, been taken, hence the above values differ slightly from those for the civil year given further on.

Moreover, Mr. Renou calls attention to the fact that the temperature assigned to Paris by M. Flammarion ($51^{\circ}4$) is too high by about $1^{\circ}4$.

We ought also to mention two papers upon the subject read by Mr. C. Harding before the Royal Meteorological Society and reported on pages 86 and 179 of our last volume.

It is obviously of much interest to know the area over which this cooling has prevailed and its relative intensity. At present we have only had time to collect returns from a few stations just as an illustration of what is wanted. The Greenwich values are taken from Mr. Glaisher's tables, those for Paris have been kindly furnished by Mr. Renou from the Observatory Parc St. Maur, those from Brussels by M. Lancaster, of the Observatoire Royal, and those from Toronto are taken from the *Canadian Monthly Weather Review*. The following little table epitomizes the results, whence it will be seen that the effect has certainly been much more marked at Brussels than in this country.

	Greenwich.		Paris.		Brussels.		Toronto.
1885.	0	-	5	-	1.1	-	2.6
1886.	+ 1	+	6	-	1	-	5
1887.	- 8	-	2.1	-	2.2	+	0
1888.	- 1.0	-	1.9	-	2.2		

On considering the above facts, it occurred to us that we had heard of some change in the position of the thermometers at Brussels, and we asked M. Lancaster about it. From his reply, it appears that the values for 1885 to 1888 are from thermometers in a Stevenson screen, whereas up to 1887 the exposure was at a N. window; the yearly mean in the screen is $0^{\circ}5$ lower than at the window, but as the correction for individual months is not accurately known, no corrections have been applied.

If now we apply this correction to the annual values, the above table will become

	Greenwich.		Paris.		Brussels.		Toronto.
1885.	0	-	5	-	6	-	2.6
1886.	+0.1	+	6	+	4	-	5
1887.	- 8	-	2.1	-	1.7	+	0
1888.	- 1.0	-	1.9	-	1.7		
Mean	- 4		- 1.0		- 9		

We do not think that it is necessary to pursue the subject further, as all these values are within the limits of variation of mean annual temperature.

	GREENWICH.			PARIS.			BRUSSELS.			TORONTO.		
	Monthly Mean Temp.	Diff. from Aver.		Monthly Mean Temp.	Diff. from Aver.		Monthly Mean Temp.	Diff. from Aver.		Monthly Mean Temp.	Diff. from Aver.	
		Mnthly.	Qrtly.		Mnthly.	Qrtly.		Mnthly.	Qrtly.		Mnthly.	Qrtly.
1885 Jan..	36.6	+ .1		31.6	- 3.2		32.4	- 3.9		18.0	- 4.6	
Feb..	43.9	+ 5.2	+ 1.5	44.8	+ 6.3	+ .7	44.8	+ 6.0	+ 0.1	11.1	- 11.8	- 9.0
Mar..	40.3	- .8		41.3	- 1.0		40.5	- 1.9		18.5	- 10.6	
April	47.7	+ 1.6		50.2	+ 1.1		51.1	+ 1.8		37.7	- 3.1	
May..	49.9	- 2.6	+ .1	52.2	- 3.8	+ .1	51.8	- 4.1	- 0.5	51.7	- .3	- 1.6
June..	59.5	+ 1.3		64.5	+ 3.1		63.3	+ 0.7		60.6	- 1.3	
July..	63.8	+ 2.1		65.3	+ .7		64.8	- .4		68.3	+ .7	
Aug..	58.5	- 2.4	- .6	61.1	- 3.0	- 1.3	61.2	- 3.2	- 1.7	63.5	- 3.0	- 1.2
Sept..	55.1	- 1.4		57.4	- 1.5		57.6	- 1.6		57.0	- 1.5	
Oct..	46.1	- 3.7		47.4	- 3.5		48.0	- 3.6		45.8	- .4	
Nov..	43.3	+ 1.0	- 1.0	43.2	+ .7	- 1.3	41.0	- 2.0	- 2.3	38.6	+ 2.6	+ 1.5
Dec..	38.9	- .2		35.9	- 1.1		36.8	- 1.3		28.2	+ 2.3	
1886 Jan..	36.1	- .4		36.0	+ 1.1		34.8	- 1.4		19.2	- 3.4	
Feb..	33.7	- 5.0	- 2.3	34.1	- 4.3	- 1.3	32.4	- 6.5	- 3.3	19.0	- 3.8	- 2.0
Mar..	39.6	- 1.5		41.5	- .7		40.5	- 2.0		30.2	+ 1.1	
April	46.4	+ .3		50.9	+ 1.8		49.8	+ .5		44.9	+ 4.1	
May..	53.3	+ .8	+ .2	57.5	+ 1.6	+ .4	57.6	+ 1.7	- .1	53.2	+ 1.2	+ 1.4
June..	57.8	- .4		59.3	- 2.1		60.2	- 2.4		60.9	- 1.1	
July..	63.0	+ 1.3		64.9	+ .4		65.5	+ .3		66.8	- .8	
Aug..	62.6	+ 1.1	+ 1.5	64.3	+ .2	+ 1.3	64.3	- .1	+ 1.3	65.7	- .8	- .4
Sept..	58.7	+ 2.1		62.3	+ 3.4		62.8	+ 3.7		58.9	+ .3	
Oct..	53.3	+ 3.8		54.3	+ 3.4		54.5	+ 2.8		48.5	+ 2.1	
Nov..	44.0	+ 1.6	+ .9	44.3	+ 1.9	+ 1.9	45.7	+ 2.7	+ 1.6	35.6	- .3	- .9
Dec..	36.5	- 2.6		37.4	+ .3		37.2	- .7		21.6	- 4.4	
1887 Jan..	35.6	- 1.0		31.6	- 3.2		33.2	- 2.9		18.1	- 4.4	
Feb..	38.8	0	- 1.5	35.9	- 2.5	- 3.3	36.8	- 2.2	- 3.4	21.7	- .8	- 3.1
Mar..	37.6	- 3.5		38.2	- 4.1		37.4	- 5.0		24.8	- 4.1	
April	44.1	- 2.0		46.8	- 2.3		46.4	- 2.9		39.4	- 1.5	
May..	49.8	- 2.7	- .7	52.5	- 3.5	- 1.3	52.5	- 3.4	- 2.1	58.5	+ 6.5	+ 2.3
June..	60.9	+ 2.6		63.2	+ 1.8		62.6	0		63.9	+ 1.9	
July..	66.5	+ 4.8		66.8	+ 2.3		67.5	+ 2.3		73.1	+ 5.6	
Aug..	62.5	+ 1.6	+ 1.3	63.1	- .9	- .9	63.3	- 1.1	- .5	66.2	- .2	+ 1.1
Sept..	54.0	- 2.6		54.9	- 4.0		56.4	- 2.7		56.4	- 2.1	
Oct..	45.0	- 4.6		44.0	- 6.9		46.5	- 5.2		44.2	- 2.2	
Nov..	40.8	- 1.6	- 2.4	41.0	- 1.4	- 3.0	41.6	- 1.4	- 2.9	35.1	- 0.9	- .2
Dec..	38.1	- 1.0		36.2	- .8		35.8	- 2.2		28.4	+ 2.6	
1888 Jan..	37.8	+ 1.2		33.7	- 1.1		33.6	- 2.5		15.0	- 7.4	
Feb..	35.0	- 3.8	- 1.9	31.8	- 6.6	- 3.7	30.6	- 8.3	- 4.9	21.9	- .6	- 4.8
Mar..	38.0	- 3.1		38.9	- 3.3		38.5	- 4.0		22.4	- 6.3	
April	43.4	- 2.7		45.5	- 3.6		45.1	- 4.1		38.9	- 1.9	
May..	53.0	+ .5	- 0.7	56.0	+ .1	- 1.2	55.5	- .5	- 1.6	50.6	- 1.6	- 0.4
June..	58.3	0.0		61.4	0		62.5	- .2		64.4	+ 2.4	
July..	57.9	- 3.8		60.3	- 4.3		60.5	- 4.7		66.2	- 1.5	
Aug..	59.1	- 1.8	- 2.1	61.5	- 2.5	- 2.5	62.1	- 2.3	- 2.8	66.0	- .3	- 1.2
Sept..	55.7	- 0.8		58.2	- .7		57.7	- 1.4		56.5	- 1.9	
Oct..	46.0	- 3.5		45.7	- 5.2		48.3	- 3.4		43.4	- 3.0	
Nov..	47.0	+ 4.6	+ 0.9	46.6	+ 4.1	- .1	45.5	+ 2.5	+ 0.7	37.4	+ 1.4	
Dec..	40.8	+ 1.7		37.7	+ .7		40.8	+ 2.9				
1889 Jan..				33.9	- .9		34.3	- 2.0				
Feb..				36.3	- 2.2		35.1	- 3.7				

THE FLOODS OF MARCH 8TH-9TH.

THERE is not time to treat this subject fully in the present number, but we can give a brief outline of the principal injury, and treat the subject fully on a subsequent occasion.

DAMAGE.

Oxford.—Although the rainfall here was continuous, it was not exceptional, but we have had the highest flood for ten years, owing to the enormous quantity of water coming down from Lechlade and the west.

Taunton.—This is one of the towns which generally suffers in time of heavy rain, but as far as we know does nothing towards protecting itself against the floods of the Tone. The water rose to 5 ft. in the main thoroughfares, and near the river to 6 ft., doing of course much damage both to property and to health. Between Taunton and Bridgewater, the main line of the Great Western Railway was 3 or 4 ft. under water, and therefore impassable.

Bath.—The Avon rose 15 ft. above its usual level, and the streets in the lower part of the City became flooded, and of course the houses on each side suffered likewise.

Bristol.—Here a large area has been covered with houses which ought not to have been built upon until proper engineering works were carried out for its protection from floods. Whenever there is a flood at or near Bristol, we always hear of the distress of the poor people in the Baptist Mills district, and we wonder who is responsible for covering that area with "hundreds of houses filled with water to the second storey?" Bristol is not the only place where the greed of some, has led to houses being built upon land which has at intervals been flooded, from time immemorial. This time, however, the flood was not confined to the Baptist Mills district, but invaded the centre of trade and commerce. The damage to property alone is put at £40,000 to £50,000, and to this what is to be added for chills, damp and muddy houses, illness and death?

Stratford-on-Avon.—Much ground and some roads under water; one hotel in the town so flooded that the ground floor could not be used.

Evesham.—Some of the streets 2 ft. to 3 ft. under water, and the basements of houses flooded.

Nuneaton.—Mills by the side of the river had to be closed as the ground floors were flooded and the engine fires extinguished.

Tamworth.—Water 3 ft. deep in many of the streets, and the farmers up all night moving their stock to high land; some hay ricks washed away by the floods.

Worcester.—Much damage, manufactories flooded, cattle drowned, and thousands of acres of land submerged.

Leicester.—This is another town in which much land very slightly above the ordinary level of the river Soar has been built upon, with

the natural result of frequent complaints as to floods. It appears from the newspapers that important works for facilitating the passage of storm waters, and thereby diminishing the liability to flooding were in progress, and that the contractors' plant, worth £2,000 or £3,000, was carried away and blocked up a bridge lower down, thus throttling the river and compelling it to rise higher than it would otherwise have done. As to the truth of this story we know nothing at present, but it seems probable as the damage in Leicester appears exceptional considering the rainfall which produced it. Whole streets are said to have been submerged, many factories flooded and the hands thrown out of work, the Great Northern Goods station was flooded, the horses being rescued only when the water had reached 3 ft. in their stalls. At Knight's Shoe Factory, some of the workrooms were said to have had in them 14 ft. of water.

Nottingham.—This town on the River Trent generally suffers when Leicester does so, because (1) the Trent receives the Soar, and also the (Derbyshire) Derwent a very few miles W. of Nottingham; and (2) from Nottingham to the sea the Trent has a long and devious course with a very slight fall. Hundreds of houses are stated to have been flooded, for an immense volume of water poured down from the high grounds, and the flood level rose to the same height as in 1877, that is to say (with three exceptions) to the greatest height this century.

Chester.—It is many years since the Chester Post-office officials experienced such a destructive storm as that which concluded early on Saturday morning. Snow fell continuously for 12 hours, but towards Friday midnight it gave up, and rain descended in torrents for some hours. Telegraphic communication was cut off between Chester and Cholmondeley, Malpas, Tattenhall, and Farndon, while a great number of wires were broken connecting Chester with Manchester, Liverpool and Shrewsbury. On the hills the snow lies a foot in depth.

GROUND ICE, OR ANCHOR ICE.

To the Editor of the Meteorological Magazine.

SIR,—Can you explain the cause of what we call "Anchor Frosts?" They occur only occasionally, sometimes years between. There was a remarkable one yesterday. Ice looking like congealed snow comes up from the *bottom* of the river, which is covered over with it. As the mill was not going it was not affected by it, but I have known it so troublesome in preventing the water coming on the wheel, that the mill had to be stopped.—I remain, yours very truly,

JAS. NUTTER.

[This phenomenon is, we believe, rather rare, and the explanation is not generally known; we therefore use Mr. Nutter's letter as a

nucleus around which to collect a short series of descriptions and explanations, which we will give in chronological order.—ED. *M.M.*]

METEOROLOGY, BY G. HARVEY, F.R.S., 4to, 1849, p. 144.

"The phenomenon of ice at the bottom of rivers is of very great interest. Mr. Knight discovered some in the river Teme, in Herefordshire, which he has described in the *Philosophical Transactions* for 1816. On a morning succeeding an intensely cold night, the rocky bed of the river appeared covered with frozen matter, which reflected a kind of silvery whiteness, and which upon examination was found to consist of numerous frozen spiculæ, intersecting each other in every direction, but not assuming anywhere, excepting near the shore, the state of firm compact ice.

"Many opinions have been advanced respecting the origin of ice in a situation so different from its ordinary state, and so contrary to what might be anticipated from its known specific gravity. The ordinary laws of radiation, joined to the eddies and gyrations of the running streams to which it is peculiar, seem adequate, however, to account for its formation. On the occasion which afforded Mr. Knight the opportunity of examining this phenomenon, the temperature of the surface water was just at freezing point, small pieces of ice being everywhere formed upon its more stagnant parts near the shores; and upon a millpond just above the shallow streams, in the bottom of which the ice had been formed, millions of frozen spiculæ were floating. At the end of this pond, the water fell over a low weir, and entered a narrow channel, in which its course was obstructed by points of rocks and large stones. Here numerous eddies were formed, which drew the frozen spiculæ under the water, as in a vortex. Mr. Knight found these frozen spiculæ to accumulate most abundantly upon such parts of the stones as stood opposed to the current, wherever it was not very rapid, below the little falls, or most rapid parts of the river. Upon some large stones near the shore, of which parts were out of the water, and upon pieces of native rock, under similar circumstances, the ice beneath the water had acquired a firmer texture, but appeared, from its whiteness, to have been first formed of congregated spiculæ, and to have subsequently frozen into a firm mass, owing to the temperature of the stone or rock. Ice of this kind extended in a few places eighteen inches from the shore, and lay three or four inches below the level of the surface of the water, and did not dissolve nearly so rapidly as that deposited upon stones more distant from the shore."

PHYSICAL GEOGRAPHY, BY PROF. J. YOUNG, M.D., 8vo., 1874, p. 235.

"*Ground Ice.*—Ground ice, or ice formed at the bottom of rivers, is, in some of the American streams, of considerable importance as a geological agent. The sheet, whose formation is determined by the contact of water with the stones at the bottom, which have become chilled by radiation in clear water under a cloudless sky, rises and

carries with it the fragments among which it was formed, conveying them down the stream into the open sea, and as the ice melts, distributing them over the floor of the ocean."

PHYSICAL GEOGRAPHY, BY W. D. COOLEY, 8vo., 1876, p. 328.

"The existence of what is called ground ice was long doubted; but careful observation has established the fact that at the bottom of rivers, lakes and other shallow waters ice is often formed before it begins to appear at the surface. It may be presumed that in these cases the ground is colder than the water; but the circumstance that seems to give to the bottom of the river the priority in congelation is, that there, under the edge of the stones, and averted from the current, may be found at once the vibration and the perfect shelter required for the formation of the first crystals. The ground ice thus formed grows in vertical flakes, grouped together so as to resemble some kinds of sponge. It often breaks off and floats on the surface, where it promotes congelation. In harbours on the shores of the Baltic Sea large stones, ropes, iron chains, and even anchors have occasionally been raised to the surface, by the luxuriant growth of the ground ice attached to them."

PHYSIOGRAPHY, BY PROF. HUXLEY, F.R.S., 8vo. 1882, p. 152.

"Yet there are certain conditions under which ice may be actually formed at the bottom of a stream, and remain there for some time. This formation of *ground-ice* is occasionally seen in parts of the Thames.

"Dr. Plot, the first keeper of the Ashmolean Museum at Oxford, published in the year 1677 a famous work on the Natural History of Oxfordshire, in which he refers to the freezing of the Thames in the following words:—'I find it the joint agreement of all the watermen hereabout that I have yet talked with that the congelation of our river is always begun at the bottom, which, however surprising it may seem to the reader, is neither unintelligible nor ridiculous. They all consent that they frequently meet the *ice meers* (for so they call the cakes of ice thus coming from the bottom) in their very rise, and sometimes in the underside including stones and gravel.'

"To explain the formation of such ground-ice, it has been suggested that the action of the running stream mechanically mixes the cold surface-water with the warmer water below until the temperature becomes uniform throughout; and when the air is very cold the whole mass may thus be reduced to the freezing point. The formation of ice will then be determined at the bottom, in consequence of the greater tranquillity of the water and the contact of cold stones and other objects which have become chilled by free radiation. This ground-ice is generally found in little masses clinging to stones and weeds; and when the temperature rises after sunrise, the loose bodies are lifted to the surface by the ice, just as if buoyed up with corks. The ice then floats down the river, bearing its little

freight of gravel, which is dropped on the bed of the river when the ice is broken up or melted. The Rev. J. C. Clutterbuck, who has paid great attention to the study of the Thames, tells us that he has seen 'pieces of rock, eight pounds in weight, raised by a mass from the bottom and carried down the river.* Here then is a geological agent not to be neglected, since it assists the transporting power of streams in carrying solid matter from the land seawards."

THE RAINFALL OF HELIGOLAND.

To the Editor of the Meteorological Magazine.

SIR,—I beg to state that the notice on the rainfall of Heligoland reprinted from the "Athenæum," in the last number of the *Meteorological Magazine* (p. 10), contains some errors. The mean annual rainfall of this island does not amount to 72·50 in., but only to 30·38 in., there having been committed a constant error in the reduction of Parisian cubic inches, read off on the measuring glass, into millimeters published in the reports of the "Kieler Commission zur Erforschung der Deutschen Meere," which established the meteorological station on the upper-land ("Oberland") of Heligoland in 1873.

Inspecting this station, which reports also to the Meteorological Institute at Berlin, in 1884, I placed a new gauge quite near to the old one standing on the little square before the school-house, and found afterwards that the quantities of rain measured in the new and in the old gauge were in the relation of 1 : 2·28. Reducing by this factor the old observations and adding the new and correct ones till the end of 1888, I obtain a mean annual rainfall of 30·38 in., i.e., a little less than on the West-coast of Sleswick-Holstein, as may be seen by the following comparison :—

	HELIGOLAND.		MELDORF.
	in.		in.
1885	26·85	.....	34·17
1886	26·66	.....	32·18
1887	22·14	.....	26·56
1888	29·43	.....	36·28

In order to know the influence exercised on the quantity of rainfall by the peculiar form of the island rising almost perpendicularly on all sides to a mean height of 150 ft., and therefore forcing the moist sea winds suddenly upwards, I placed another gauge on the down ("Düne") at the height of 8 ft. above the level of the sea. This little flat and sandy island (with an excellent beach for bathing) lies eastward, at the distance of three-quarters of a mile. The observations could only be made there in the months of June till September, because in the remaining part of the year nobody inhabits the down, which is almost inaccessible during rough weather.

* Report of the Thames Commissioners ; appendix 1, 1866.

The simultaneous observations made in the years 1885-87, give the result that on the upper-land falls 13·4 per cent. more rain than on the down; but I am (doubtful) not sure if a great deal of this difference may not be due to the disturbing influence of the wind, which is much stronger on the open and flat down than on the "Oberland," where the raingauge, in spite of the greater height above mean sea-level, is somewhat sheltered by the little town.

Thus, the *amount* of rainfall at Heligoland offers nothing remarkable; but an interesting feature of it is to be found in the fact, that the month of heaviest rainfall is November, whereas on the German coast of the "Nordsee" (German Ocean), this maximum occurs in September. The distribution on the months expressed in per cent. of the yearly total at Heligoland may be seen by the following table:—

January	8	May	5	September	11
February	6	June	6	October	12
March	7	July	8	November	14
April	3	August	11	December	9

It is my opinion, that this peculiarity—for the most part—can be accounted for by the difference of the temperature of the sea and of the air, this being greatest just in November. Indeed, from ten years' observations I obtain the following differences:—

January	3·6	May	—2·0	September	3·4
February	2·0	June	—2·2	October	5·6
March	1·3	July	—0·9	November	6·8
April	—1·3	August	1·4	December	6·1

i.e., in November the mean temperature of the surface of the sea is 6·8° Fahr. higher than that of the air in about 160 ft. above the level of the sea.

G. HELLMANN.

Berlin, March 5th, 1889.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of the Royal Meteorological Society was held on February 20th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair. Mr. H. D. Richmond, F.C.S., and Dr. F. G. Smart, M.A., F.L.S., were elected Fellows of the Society. The following papers were read:—1. "Report on the Helm Wind Inquiry," by Mr. W. Marriott, F.R.Met.Soc. The term "helm wind" is applied to a strong wind coming westwards from the Cross Fell range of mountains in Cumberland, which runs from north-north-west to south-south-east. The range is high and continuous, and is not cut through by any valley. Cross Fell is 2,900 feet above sea level. From the top of the mountains to the plain on the west there is a fall of from 1,000 to 1,500 feet in about a mile and a half

At times when the wind is from some easterly point a helm cloud forms over this district, the chief features of the phenomenon being as follows :—A heavy bank of cloud rests along the Cross Fell range, at times reaching some distance down the western slope, and at others hovering just above the summit, while at a distance of two to six miles west from the foot of the Fell a slender roll of dark cloud appears in mid-air and parallel with the helm cloud : this is the helm bar. The space between the helm cloud and the bar is usually quite clear, while to the westward the sky is generally completely covered with cloud. A cold wind rushes down the sides of the Fell and blows violently till it reaches a spot nearly underneath the helm bar, when it suddenly ceases. The observations that have been made in the district during the past three or four years show that the helm wind is not such a rare occurrence as it was popularly supposed to be, the bar having been observed on forty-one occasions in 1885, on sixty-three in 1886, and nineteen in 1887. 2. "An Atmospheric Sketch," by Mr. F. A. Velschow, F.R.Met.Soc. 3. "The Drought in New South Wales in 1883-4, and Rainfall at Corella, 1879-88," by the Ven. Archdeacon Wynne, F.R.Met.Soc.

SNOWSTORM AT TORQUAY.

To the Editor of the Meteorological Magazine.

SIR,—We have just experienced (from 2nd to 5th inst.) some of the severest snowstorms ever known here, the depth on the ground at 11 p.m. on the 3rd, viz. 7 in., having been only once equalled (on January 19th and 21st, 1881), and never exceeded since the observations were begun in August, 1876. Snow fell from 7.50 to 10 p.m. and at 11 p.m. on Saturday, 2nd (with an E.S.E. breeze); on the 3rd from the early morning up to 10.30 p.m. (with the exception of half-an-hour from 10.30 to 11 a.m.), with an Easterly breeze veering to S.S.W. at 7 p.m. and backing to S.E. at 9 p.m.; on the 4th from 7.50 to 9.45 a.m., 10.25 a.m., at times to 3.20, and from 3.30 p.m. to the early morning of the 5th, accompanied by a strong S.S.E. wind, backing in the evening of the 4th to E. The amount in the rain-gauge (melted) was 0.32 in. on the 2nd, 0.46 in. on 3rd, and 0.38 on 4th. The ground was covered with snow from 9 p.m. on the 2nd up to to-day, the max depth being 7 in. at 11 p.m. on 3rd; in spite of the thaw on 4th and 5th it was 1½ in. deep this morning. Bar. was about the average height till yesterday, when it rose above it.—Yours truly,

EDWIN E. GLYDE.

Kirkham, Babbacombe, Torquay, March 6th, 1889.

FORMS OF SNOW AS INDICATIVE OF COMING WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—It does not seem to be generally known that the form and character of snow flakes are sure forecasters of coming weather. This fact was mentioned to me more than 30 years ago by Mr. E. T. Loseby, of Leicester, and we have observed and verified it ever since, and it has been verified by very many others to whom it has been shown. It may be relied on most thoroughly; so that the clouds themselves send us true telegrams of the coming weather, and if the rain drops had a form that we could note, no doubt they would do the same.

If snow falls in thin small spikes, like Epsom salts, it will soon pass away, and the weather become milder; but if the flakes be like stars, or asterisks with 6 radii ✱, there is a certainty of cold weather to follow for two and perhaps six weeks. Hard bally flakes have much the same force as forecasters of severe weather. They are whiter, harder, and fall to the ground much more rapidly than other snow, and sometimes in a short shower of less than half-a-minute; shining very markedly on the surface of the main body of fallen snow. On Sunday and Monday, February 24th and 25th, they fell copiously, both stars and balls, and the cold weather which will certainly follow and has followed so far, will confirm the truth of these observations. The larger and harder the stars, the colder will be the weather which follows.

EDWARD N. POCHIN.

Barkby Vicarage, Leicester, Feb. 6th, 1889.

SALT SNOW.

To the Editor of the Meteorological Magazine.

SIR,—During severe squalls from the NN.W. and N., with snow on February 8th, it was noticed by persons exposed to the squalls that the driving snow had a distinctly saline taste, and the following day it was noticed that leaves of evergreens, &c., were encrusted with a very slight film of saline matter; on testing some of the snow it was found that the quantity of salt (Na Cl) contained in a gallon of melted snow was 3·83 grains—the salts of Magnesium and Calcium, always present in sea water were not determined, they would amount to over a grain in the gallon of the snow water, this though by no means a large amount of solid matter in water, is a remarkable amount in snow, considering that the nearest sea coast to this in a NN.W. direction is quite 60 miles distant, from whence the sea water mingled with the snow must have been carried across the country by the squalls.

Yours truly,
P. DUDGEON.

Cargen, Dumfries, N.B.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, AUGUST, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	100	°	°	inches		0.10
England, London	84.6	10	43.9	19	69.3	52.1	52.2	79	126.6	38.4	3.61	14	5.9
Malta	97.4	17	64.0	21	85.1	69.8	63.3	65	146.5	56.9	.08	1	1.0
Cape of Good Hope. ...	88.0	23	38.5	12	62.3	48.1	...	...	...	...	2.90	9	5.5
Mauritius	77.5	30	57.0	7	74.8	64.5	59.9	74	124.5	48.1	2.87	20	5.0
Calcutta	92.5	3	73.8	24	86.5	77.8	77.5	85	156.5	15.7	26.02	26	9.2
Bombay	86.4	9	74.6	2	83.5	76.6	75.4	86	138.6	73.8	11.43	30	9.3
Ceylon, Colombo	87.7	25	73.8	3	85.9	76.4	71.9	78	144.5	70.0	1.10	11	6.4
Melbourne	67.1	30	30.0	5	56.7	40.1	41.0	75	115.5	23.4	.99	12	6.0
Adelaide	70.7	30	33.7	7	59.6	44.6	43.8	74	127.5	23.5	2.39	20	6.3
Wellington	62.0	20	40.0	1	55.6	44.8	44.6	82	120.0	29.0	5.29	21	4.5
Auckland	63.0	15	43.0	2	59.2	47.9	47.2	79	122.0	35.0	3.40	21	7.0
Jamaica, Kingston	92.9	22	68.8	28	90.4	73.3	72.6	77	...	...	2.44	...	...
Barbados	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	84.9	16	47.3	23	76.1	56.5	55.9	69	...	40.8	2.91	13	5.5
New Brunswick, Fredericton	78.7	10	43.5	21	69.3	52.5	54.1	77	...	...	4.20	21	6.8
Manitoba, Winnipeg ...	97.0	23	30.3	31	75.0	46.5	52.0	78	...	...	1.13	13	3.5
British Columbia, Victoria	81.0	30	43.0	21, 27	72.5	49.4	...	...	...	...	.42	2	..

REMARKS, AUGUST, 1888.

MALTA.—Mean temp. 76°·4; mean hourly velocity of wind 8·7 miles. Sea temp. fell from 79°·9 to 76°·4. L seen on 26th and 27th. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, of dew point 1°·2, and R 1·02 in. above their respective averages. Mean hourly velocity of wind 11·7 miles, or 1·2 below average; extremes 27·8 on 5th and 1·7 on 22nd. Prevailing direction, E.S.E.

C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·8, and of dew point 1°·1 below average; humidity and mean amount of cloud very near the average; R·87 in. below average. Prevailing winds N. and N.W.; strong on 8 days. Heavy dew on 9 days. Hoar frost on 9 days. Fogs on 5 days. Ice on 5th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure·056 in. above average. Mean temp. 2°·0 below average. Sky considerably more clouded than usual, but rainfall only slightly higher than the average for previous 31 years. C. TODD.

Wellington.—Generally showery. Prevailing winds S. and S.E. Hail on 30th and 31st. Slight earthquakes on 16th and 17th. Mean temp. 2°·2 above the average. Rainfall slightly, and wet days considerably, more than the average. R. B. GORE.

Auckland.—A warm, mild month. Rainfall nearly an inch below the average, mean temp. considerably above the average, and barometric pressure slightly above.

T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 FEBRUARY, 1889.

 [For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2.91	XI.	Castle Malgwyn	2.37
"	Margate, Birchington...	2.14	"	Rhayader, Nantgwillt..	5.67
"	Littlehampton	2.00	"	Carno, Tybrith ...	3.03
"	Hailsham	2.62	"	Corwen, Rhug	1.65
"	Ryde, Thornbrough	1.82	"	Port Madoc	4.44
"	Alton, Ashdell	2.31	"	I. of Man, Douglas	3.08
III.	Oxford, Magdalen Col..	1.82	XII.	Stoneykirk, Ardwell Ho.	3.09
"	Banbury, Bloxham	1.91	"	New Galloway, Glenlee	4.01
"	Northampton	1.75	"	Melrose, Abbey Gate...	2.20
"	Cambridge, Beech Ho...	1.52	XIII.	N. Esk Res. [Penicuik]	2.00
"	Wisbech, Bank House..	1.89	XIV.	Ballantrae, Glendrishaig	2.74
IV.	Southend	1.71	"	Glasgow, Queen's Park.	2.55
"	Harlow, Sheering ...	1.90	XV.	Islay, Gruinart School..	2.98
"	Rendlesham Hall	2.25	XVI.	Dollar	2.41
"	Diss	2.66	"	St. Andrews, Pilmour Cot	1.04
"	Swaffham	1.65	"	Balquhider, Stronvar..	4.73
V.	Salisbury, Alderbury ...	1.65	"	Dunkeld, Inver Braan..	1.30
"	Warminster	2.28	"	Dalnaspidal H.R.S. ...	5.37
"	Bishop's Cannings	1.90	XVII.	Keith H.R.S.	2.67
"	Ashburton, Holne Vic...	3.90	"	Forres H.R.S.	2.89
"	Hatherleigh, Winsford.	4.39	XVIII.	Strome Ferry H.R.S....	5.12
"	Lynmouth, Glenthorne.	3.58	"	Fearn, Lower Pitkerrie.	2.34
"	Probus, Lamellyn	3.05	"	Loch Shiel, Glenaladale	10.51
"	Launceston, S. Petherwin	3.50	"	N. Uist, Loch Maddy ...	3.24
"	Wincanton, Stowell Rec.	2.28	"	Invergarry	4.49
"	Taunton, Lydeard Ho...	2.26	"	Loch Ness, Drumnadrochit	4.14
"	Wells, Westbury	2.17	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	1.54	"	Forsinard H.R.S.	...
"	Ross	1.29	"	Watten H.R.S.	2.73
"	Wem, Clive Vicarage ...	1.32	XX.	Dunmanway, Coolkelure	4.26
"	Cheadle, The Heath Ho.	2.48	"	Fermoy, Gas Works ...	2.85
"	Worcester, Diglis Lock	1.59	"	Tipperary, Henry Street	3.35
"	Coventry, Coundon	2.00	"	Limerick, Kilcornan ...	3.09
VII.	Ketton Hall [Stamford]	2.10	"	Miltown Malbay	2.93
"	Grantham, Stainby	1.81	XXI.	Gorey, Courtown House	2.32
"	Horncastle, Bucknall ...	1.87	"	Navan, Balrath	2.35
"	Mansfield, St. John's St.	1.98	"	Mullingar, Belvedere...	2.59
VIII.	Neston, Hinderton	1.72	"	Athlone, Twyford	2.31
"	Knutsford, Heathside ...	1.99	"	Longford, Currygrane...	1.89
"	Lancaster, South Road.	2.73	XXII.	Galway, Queen's Coll..	4.07
"	Broughton-in-Furness ..	...	"	Clifden, Kylemore	3.53
IX.	Wakefield Prison	1.68	"	Crossmolina, Enniscoe..	4.33
"	Ripon, Mickley	1.40	"	Collooney, Markree Obs.	3.43
"	Scarborough, West Bank	1.76	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	1.25	XXIII.	Warrenpoint	2.57
"	Middleton, Mickleton ..	1.57	"	Seaford	2.88
X.	Haltwhistle, Unthank..	2.25	"	Belfast, New Barnaley..	3.71
"	Shap, Copy Hill	1.94	"	Bushmills, Dundarave...	3.24
XI.	Llanfrechfa Grange	1.23	"	Stewartstown	2.86
"	Llandovery	4.02	"	Bunorana	3.57

FEBRUARY, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average, 1870-9	Greatest Fall in 24 hours.		Days on which 101 or more fell.	Max.		Min.				
				Dpth.	Date.		Deg.	Date.	Deg.	Date.			
											inches.	in.	
I.	London (Camden Square) ...	2.28	+	.64	.63	10	18	58.1	17	20.4	13	18	22
II.	Maidstone (Hunton Court)...	2.43	+	.81	.85	10	20	...	...	...	...	...	...
III.	Strathfield Turgiss	1.86	+	.11	.54	10	15	56.3	17	13.5	13	18	23
III.	Hitchin	1.63	+	.03	.42	6, 10	17	54.0	17	16.0	12	23	...
IV.	Winslow (Addington)	2.29	+	.48	.59	10	17	54.0	17	12.0	12a	18	23
IV.	Bury St. Edmunds (Culford) ..	1.29	—	.48	.50	9	...	46.0?	28	11.0	9	...	...
V.	Norwich (Cossey)	1.37	—	.38	.20	11a	18	...	...	...	...	...	...
V.	Weymouth (Langton Herring) ..	2.04	...	...	.44	10	12	52.0	17b	24.0	10	16	...
"	Barnstaple	2.58	—	.61	.82	13	12	60.0	20c	28.0	10	...	...
"	Bodmin	3.04	—	1.33	.53	13	22	50.0	1, 17	27.0	28	11	15
VI.	Stroud (Upfield)	1.58	—	.67	.51	10	17	54.0	18b	21.0	11	20	...
"	Churchstretton (Woolstaston) ..	1.27	—	1.23	.23	10	15	54.5	17	18.5	11	19	22
"	Tenbury (Orleton)	1.62	—	.85	.51	10	16	58.8	17	16.2	12	15	17
VII.	Leicester (Barkby)	1.89	+	.25	.46	6	16	56.0	1	8.0	12	24	27
"	Boston	2.01	+	.23	.45	10	17	55.0	1	11.0	12	18	...
"	Hesley Hall (Tickhill)	1.51	—	...	.36	10	18	58.0	1	21.0	13	18	...
VIII.	Manchester (Ardwick)	2.26	+	.07	.62	13	15	59.0	17	29.0	10g	4	...
IX.	Wetherby (Ribston Hall) ...	1.67	—	.48	.54	3	14	...	...	...	...	...	...
"	Skipton (Arncliffe)	4.55	—	.09	1.76	12	13	...	...	...	...	...	...
"	Hull (People's Park)	1.65	—	.60	.25	10	22	...	...	...	...	...	...
X.	North Shields	1.31	—	.53	.26	11	19	57.0	1, 18	19.5	10	18	20
XI.	Borrowdale (Seathwaite)	9.53	—	1.92	3.12	13	17	...	...	...	...	...	...
"	Cardiff (Ely)	2.22	—	1.44	.55	10	17	...	...	...	...	...	...
"	Haverfordwest	3.40	—	1.05	.70	13	21	51.7	17d	25.4	25	13	21
"	Plinlimmon (Cwmsymlog) ...	4.50	...	...	.85	6	18	...	...	...	...	...	...
XII.	Llandudno	1.94	—	.35	.58	6	16	54.0	1	27.5	11	6	...
"	Cargen [Dumfries]	1.68	—	2.13	.38	13	12	52.8	1	20.8	10	19	...
"	Jedburgh (Sunnyside)	1.35	—	.41	.28	12	10	54.0	1e	18.0	10	21	...
XIV.	Old Cumnock	3.17	+	.31	.49	12	16	52.0	1, 18	12.0	11h	22	...
XV.	Lochgilphed (Kilmory)	4.81	+	.42	.82	13	17	...	...	...	...	...	...
"	Oban (Craigvarren)	4.03	—	...	.65	12	20	51.3	18	21.6	10	9	...
"	Mull (Quinish)	4.42	...	...	1.04	13	21	...	...	...	...	...	...
XVI.	Loch Leven Sluices	1.90	—	1.06	.30	14	11	...	...	...	...	...	...
"	Dundee (Eastern Necropolis) ..	1.40	—	1.15	.35	25	13	53.9	18	19.9	10	20	...
"	Braemar	2.60	—	.07	.74	8	19	50.8	1	17.3	10	20	26
"	Aberdeen (Cranford) ...	2.40	...	...	.40	25	24	56.0	1	22.0	9	14	...
VIII.	Lochbroom	5.70	...	...	1.16	18	23	...	...	...	...	...	...
"	Culloden	2.53	+	1.48	...	...	...	55.0	1	18.0	10	14	25
XIX.	Dunrobin	...	...	...	...	...	...	...	...	...	...	...	...
"	S. Ronaldsay (Roeberry)	3.95	+	1.96	.49	16	22	...	...	...	...	...	...
XX.	Cork (Blackrock)	2.71	—	1.88	.68	2	15	...	...	...	...	...	...
"	Dromore Castle	4.87	...	...	1.15	13	14	56.0	7	27.0	23	...	...
"	Waterford (Brook Lodge) ...	2.41	...	...	.45	12	18	57.0	1	25.0	11	11	...
"	O'Briensbridge (Ross)	4.46	...	...	1.03	10	18	53.0	20	25.0	17	15	...
XXI.	Carlow (Browne's Hill)	2.09	—	.83	.54	10	22	...	...	...	...	...	...
"	Dublin (Fitz William Square) ..	2.45	+	.29	.74	10	20	55.0	1	21.7	11	4	21
XII.	Ballinasloe	2.55	+	.04	.57	10	21	50.0	1f	20.0	11	16	...
XIII.	Waringstown	2.23	—	.02	.31	6	19	55.0	16	8.0	10	18	21
"	Londonderry (Creggan Res.) ..	4.26	...	...	.45	2	24	...	...	...	...	...	...
"	Omagh (Edenfel)	2.65	+	.37	.58	13	27	51.0	17	18.0	10	16	...

1 And 20. c And 21. d And 18. e And 17, 18. f And 16, 17. g And 12, 13. h And 12.

+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—The chief characteristic of this month was that no kind of weather lasted long together. Frosts of great severity (10° 8 on grass on 13th) were followed immediately by mild weather. Even the deep S of the 10th was of short duration. The end of the month was cold and winterly. Gale on 3rd.

HITCHIN.—A most winterly month; amongst the coldest Februaries in our record. Very deep snow on the 10th.

WINSLOW, ADDINGTON.—The first day of February was very mild, with a max. temp. of 53° and a min. of 45° , but from that date until the 17th it was cold and unsettled, particularly cold on the 12th and 13th. From 17th to 20th was much milder again, and the remainder of the month was cold and comfortable. On the 14th a large flood occurred, caused by the rapid melting of the snow that fell on the 10th.

WEYMOUTH, LANGTON HERRING.—E or S fell on no less than 20 days, but on 8 of these days less than .01 fell, mostly as S; total fall .65 in. below the average. Mean temp. (37° 8) 2° 3 below the average. The fluctuations of the bar. on the first 16 days of the month was exceptionally great. During the last 6 days the temp. never reached 40° .

BODMIN.—Mean temp. for the month 39° 1.

UPFIELD, STROUD.—Snow on the 10th, about five inches in depth.

WOOLSTASTON.—The first 12 days were bitterly cold, S falling on five days; on the 13th a rapid thaw set in, but cold weather returned during the last week and S again fell on the last two days. There was a violent gale on the 3rd. Mean temp. 36° 2.

ORLETON.—With the exception of a warmer period from 13th to 22nd, the month was generally cloudy, gloomy, and cold, with severe frosts and a mean temp. 1° 8 below the average of 23 years. S fell on the 10th, covering the land to the depth of about 7 inches, which cleared off again on the 14th. Before and after that time it was frequently lightly covered with S. The fall of E and S was nearly an inch below the average, but pressure was subject to frequent sudden, but not great fluctuations, and there was consequently a prevalence of rough winds, chiefly from the N. and N.W. There was distant L on the night of the 2nd, with S and a great wind for several days.

BARKEBY.—A cloudy month. Mean temp. 35° 3. Gale on 3rd. Snow fell to the depth of about 9 inches on 10th.

BOSTON.—Temperature of the month two degrees below the average. Heavy gales on the 8th and 9th.

MANCHESTER.—The month was rather unpleasant, with cold east wind, E and S at intervals, and some fair days. The temp. was not low, except early in the month.

HULL.—The weather during the month was remarkable for the frequent, though generally slight, falls of H, sleet, and S. The H stones were often exceeding small and always soft.

WALES.

HAVERFORDWEST.—The first week was very cold, and it continued cold up to the 15th. It was then rather milder and very wet up to the 23rd, from which date sharp frosts prevailed to the end of the month.

SCOTLAND.

CARGEN.—The first half of the month was very unsettled, the fluctuations both of the bar. and ther. being sudden and great. Severe squalls from the N.N.W. and N. with S occurred on the 8th. Mean temp. $2^{\circ}4$ below the average.

JEDBURGH.—The weather was cold and ungenial with frequent showers of S, which was melted quickly by the sun. Vegetation has been still, but country work has not been stayed much, and land is in good order for seed.

OBAN, CRAIGVARREN.—Rainfall was pretty general throughout the month, and several severe gales were experienced. The temp. was normal, but very little S fell.

MULL, QUINISH.—A cold wet month, the first half being unusually stormy. A tremendous gale from N.W. on the 8th.

LOCHBROOM.—The bad weather that began on the 22nd of January continued without interruption until the 22nd of February with varying rigour, but at times with great storms, especially on 18th, when we had a terrific gale and an unusually high flood. Seldom were our small rivulets seen in such force.

CULLODEN.—The month was free from heavy S storms; frost, however, prevailed, all through the month. Labour well forward.

ROEBERRY.—Very rough from 1st to 19th; gales from S. to N.E. The remainder of the month had moderate winds but was cold. On the whole a very unsettled month.

IRELAND.

CORK.—Cold and at times stormy, with frequent showers and a few slight falls of S.

WATERFORD.—Mean temp. $41^{\circ}1$. S nearly an inch below the average.

DUBLIN.—An unsettled, windy, wet and cold month, with N.W. wind preponderating. A severe snowstorm on the 10th, and on the 1st a fresh gale from W. Very changeable weather prevailed during greater part of week ending 16th, which began with a snowstorm and ended with warmth and squalls; the third week, at first mild, soft and cloudy, became cooler, drier and brighter, and for the remainder of the month the weather was very inclement. S or sleet fell on 8 days, H on 7 days, fogs on 4 days, high winds on 13 days reaching the force of a gale on 5 days. The temp. exceeded 50° in the screen on 8 days, and on 7 days did not rise to 40° .

EDENFEL, OMAGH.—The month commenced with the mild and rainy weather which has been characteristic of the winter, but on the 7th gave place to violent snow squalls, followed on the 10th by a steady snow fall, averaging 6 inches in depth, with a temp. of 18° . On the 13th a thaw with heavy rain again set in, and the remainder of the month was generally wet and unsettled, with a tendency to dry polar winds and light snow on 27th and 28th.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXIX.]

APRIL, 1889.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE FLOODS OF MARCH 8TH AND 9TH.

(Concluded from p. 21.)

WE add a few more general notes upon these floods, and shall then proceed to consider the numerical data with which we have been favoured.

Taunton, Halse House.—On the 8th, over two inches of rain fell. The water was 4 ft. deep down at Halse Water, and the road quite impassable on Friday afternoon. At Mr. Pratt's the water stood 6 in. deep in the bakehouse. Mrs. Pratt said that she had known the house for 60 years, and never saw water in it before. At Bishop's Lydeard the flood was very bad. Mr. Smith and Dr. Mead went about putting food into the bedroom windows to the people, as all the lower rooms were flooded. There were no trains on the Bishop's Lydeard branch on Saturday, the 9th, and none below Bridgewater for 24 hours. The water was so deep that it put out the engine fires.

Bath Literary Institution.—Nine inches of snow fell on the 4th, and much of this was still unmelted on the 6th. The river was about 6 ft. above its ordinary level on Friday, but by the following morning it had risen 8 or 9 ft. higher. The stand containing the instruments was surrounded with about 3 ft. of water, and the observer had to be carried there on a man's shoulders, who waded in up to his waist. The height of the flood varied in different places; here, in the Institution Gardens, it was about 22 in. below the unprecedented one of 1882; about a half-mile lower down, it was said to be 16 in. below the corresponding point; and in other places the difference was reported as more than 2 ft.

Bristol, Bishopston.—The exceptionally heavy rainfall deserves special record, the more particularly so, as it occurred in what is usually the driest season of the year. The fall was continuous during the 34 hours preceding midnight on March 8th, and during this interval the depth measured reached 2·91 in. Very disastrous floods resulted from this enormous downpour and were much more extensive than those of October, 1882, and do not appear to

have been equalled since April, 1809. There was a heavy snow-storm here throughout Monday, March 4th, which covered the ground to the depth of 6 in. ; and the thaw which occurred on the 5th and 6th, served to intensify the effect of the heavy rain which fell on succeeding days.

Ross, The Graig.—I find no record for this district, and have no register of my own, of more than about half as much at this period of the year. Probably March 14th–15th, 1851, would be the largest previous fall approaching in amount. We have had no flood on the river Wye, and no serious one on smaller streams.

Cardiff, Lhwymarthen.—Snow fell on 3rd and 4th together to a depth of 9 in. Some roads were submerged for a day or so, but no great damage was done here.

Woolstaston Rectory.—There was a slight fall of snow (·01) on the 1st and 3rd, but none was left when it began again on the 6th. The great fall on the 8th was perfectly even, and measured almost exactly 1 ft. in depth here ; but a little higher up on the Longmynd it was much deeper, about 1½ ft.

Coventry, Priory Row.—No snow was on the ground on the evening of March the 6th. Early on the morning of the 7th it was snowing heavily—dry snow. At 9 a.m. it was beginning to thaw, and soon changed to rain. About 11 at night of the 8th, it again turned to snow, which was perhaps an inch deep in the morning of the 9th, but soon melted away. The total fall (2·43) occupied less than 48 hours. The fall was greater on the west side of Coventry, and smaller at Stoke, to the east.

Leicester, Rotherby Hall.—Very large floods all along the valley of the Wreake.

In the following table we give the daily fall on each of the three days, March 6th, 7th and 8th, and the total for the three at all stations from which we have yet heard, and at which the total exceeded 2 inches.

It will simplify matters if, in the first place, we select those at which the fall exceeded 3 inches. They are—

Holne Vicarage.....	4·25	Bishopston.....	3·34
Lydeard Ho.....	3·67	Llanfrechfa ...	3·08
Radstock	3·74	Wickwar	3·26
Clifton	3·20	Upfield	3·63

The first of these has little connection with the inquiry. Holne Vicarage is on Dartmoor, with a mean rainfall of 70 or 80 inches a year, therefore a fall of 4·25 inches in three days is not very exceptional, and as the rivers ordinarily have to carry off heavy falls, no serious damage ensued. Damage occurs only where the volume of the rainfall water is unusual, or where human beings (more foolish than beavers) have built upon lands liable to flooding. The high figures from Lydeard and Radstock explain the flooding at Taunton, and the five other returns explain that produced at Bristol by the

overflow of the (Gloucestershire) Frome. But most undoubtedly the terrible loss at Bristol (put at £100,000) is due to neglect of reasonable supervision of the watercourses, and to building where houses should not have been placed until the watercourses had been entirely reorganized. It is a fine of £100,000 for neglect. But we fear that few towns will profit by the lesson; most of them will wait for a lesson at their own expense.

The Leicester floods were apparently due to accident, the rains, though heavy, not being what can be called exceptional.

Rainfall, March 6th—8th, 1889.

Counties.	Stations.	6th.	7th.	8th.	Total, 6th-8th.
		in.	in.	in.	in.
Devon	Torquay (Babbacombe)	1·28	·73	·51	2·50
„	Ashburton (Holne Vicarage)	1·23	1·81	1·21	4·25
„	Teignmouth (Woodway) ...	·77	·76	·55	2·08
„	Okehampton	·42	·94	1·27	2·63
„	Hartland Abbey	·57	·65	1·20	2·42
„	Barnstaple	·50	·84	1·00	2·34
„	Lynmouth (Glenthorne).....	·35	·72	1·70	2·77
Dorset.....	Beaminster	·82	·72	·49	2·03
„	Sturminster (Haselbury) ..	·87	·91	·54	2·32
Somerset.....	Taunton (Lydeard Ho.)....	·40	·76	2·51	3·67
„	Wells (Westbury)	·40	·52	1·13	2·05
„	Radstock	1·33	1·03	1·38	3·74
„	Bath	·63	·74	1·20	2·57
Gloucester ..	Bristol (Clifton)	·46	·91	1·83	3·20
„ ..	„ (Bishopston)	·43	·96	1·95	3·34
Glamorgan...	Cardiff (Ely).....	·40	·97	·93	2·30
Monmouth...	Marshfield (Llwynarthan)...	·43	·90	1·14	2·47
„ ..	Llanfrehfa	·48	1·18	1·42	3·08
„ ..	Monmouth (Hendre)	·19	·84	1·69	2·72
Hereford ..	Ross	·15	·90	1·53	2·58
Gloucester ..	Wickwar	·42	1·00	1·84	3·26
„ ..	Cirencester (Further Barton) ..	·42	·89	1·04	2·35
„ ..	Stroud (Upfield)	·43	1·10	2·10	3·63
Worcester ..	Evesham (Lansdowne)	·15	·75	1·63	2·53
„ ..	Worcester (Diglis Lock) ..	·15	·62	1·24	2·01
Warwick ..	Nuneaton (Bedworth)	·21	·85	1·29	2·35
„ ..	Coventry (Coundon)	·14	1·13	1·47	2·74
„ ..	„ (Priory Row).....	·18	·85	1·40	2·43
Leicester ..	Barkby Vicarage.....	·09	·85	1·94	2·88
„ ..	Ratcliffe College	·00	·83	1·91	2·74
„ ..	Rotherby Hall.....	·02	·76	2·04	2·82
„ ..	Loughborough ..	·06	·75	2·06	2·87
Derby	Belper	·12	·39	1·53	2·04
Nottingham ..	Mansfield	·10	·40	1·75	2·25

REVIEWS.

The Great Storm off the Atlantic Coast of the United States, March 11th to 14th, 1888. By EVERETT HAYDEN. Hydrographic Office, U.S.A. Nautical Monograph No. 5. Government Printing Office, Washington, 1888. 4to, 66 pages, 6 plates.

THIS monograph would have greatly delighted Admiral FitzRoy, for the charts are tinted in red (for warmth) and blue (for cold), just as he loved to have them, and all through, the author shows more sympathy with the Admiral's habits and thoughts than has been shown in any English work that we have seen.

The storm is the one which produced the "Blizzard in New York, March 12th," which was described in the *Meteorological Magazine* for April last, p. 34. The work is illustrated by a synoptic chart of the Eastern portion of the United States and of Canada, and of the Western Atlantic for 7 a.m. of each day from March 11th to 14th, both inclusive, also by a track chart and a barometer diagram. The text gives a history of the principal events of each day in a series of chapters, which may almost be regarded as diaries. These are followed by others on the use of oil in stilling waves, on the wreckage along the coast, and by various appendices giving the original statements as sent by the observers.

We notice in the preface some remarks in apology for delay in publication. No such apology is needed; there are few establishments in the world which would have issued a work so promptly. We could quote many offices which have not issued their reports for 1887, some which have not yet issued 1886, and at least one which has not yet finished 1885.

Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung. By A. W. GRÜTZMACHER. Jahrgang V., 1886. Faber'sche Buchdruckerei, Magdeburg 1888. 4to, 40 pages, 14 plates.

THE high level of excellence at which this publication was fixed by Dr. Assmann is being maintained by his successor, and as we have on a previous occasion fully described the publication, we need only chronicle the above fact, and note one or two changes.

The excellent plan of reproducing the barograph traces for such periods only as show sudden and marked changes is continued.

All the daily records of the Jordan sunlight recorder are reproduced on their natural size, and they are most interesting. It seems to us also to be a better plan to give the total duration of sunshine in minutes, instead of in hours and minutes as has hitherto been the practice. A curve representing the total sunlight of each month might with advantage be added on page 32, but on the whole the work reflects much credit upon the editor, and on the proprietors of the *Magdeburgischen Zeitung*, who we believe bear the entire cost.

Studi sulla comparazione degli Anemometri. PROF. DOMENICO RAGONA.
Estratto dagli Annali della Meteorologia Italiana Pt. 1, 1886.
Metastasio, Roma 1888, fol. 16 pages, 1 plate.

NOTHING is so hard to kill as error. About forty years since, our dear old friend Dr. Robinson stated that anemometer cups moved with one third of the velocity of the wind. He, Dohrandt and others have since shown that the rule was wrong, and that the factor is never 3 to 1, but is variable, but probably not far from 2·3 to 1; papers on the subject have appeared in many of the leading publications of Europe, and yet here on the very first page of his memoir Prof. Ragona says:—

“I centri degli emisferi percorrono una circonferenza uguale a metri 3,333 e in conseguenza, giusta la ben nota *convenzione fondamentale*, una rotazione del mulinello corrisponde a 10 metri della velocità del vento.”

It is quite possible that in the words which we have put in italics, he is firing a sly shot at the many important offices, the English one among them, which go on using the factor of 3 to 1 when they know that it is incorrect.

As regards the present paper (which is a comparison of two anemometers each driven by Robinson's cups) the factor employed is of no importance, and therefore, we can pass on to state briefly the object of the memoir. It describes the pattern of anemometer made by Brassart and adopted by the Italian Meteorological Office,* and explains comparisons made between it and a small one by Salleron; the results are we think very similar to those which have been obtained in this country, and not less unsatisfactory.

Vero andamento diurno della Temperatura. PROF. D. RAGONA. Società Tipografica, Modena, 1889, 4to, 27 pages.

THIS is a discussion of two years' records (June 1869 to May 1871), from the self-recording metallic thermometer at Modena, made by Salleron, of Paris. The period is of course too short to give absolute values, but the tables show clearly how much later in the day the maximum temperature occurs in Modena than in this country.

Climatology of New Jersey. By J. C. SMOCK. [From the final report of the State Geologist, Vol. I.] Murphy, Trenton, New Jersey, U.S.A., 1888, 8vo. 96 pages.

SOMETIMES those who come fresh to a subject treat it better than those whose whole lives have been devoted to it. Mr. Smock, is, we believe, a geologist, and we have no recollection of meeting with his

* We venture to suggest that it would be improved if the velocity of rotation of the communicating rod were lessened, by the wheel *p* being decreased in size, and *q* increased.

name in connection with meteorology, and yet here is a memoir which we can describe as aggravatingly good—aggravatingly, because we cannot afford space for the many quotations which we should like to make.

New Jersey is slightly larger than Wales, and in about the same latitude as Madrid and Constantinople, yet its mean temperature is scarcely equal to that of London, while its vicissitudes are extreme. An interesting plate gives the monthly mean temperature for four districts, and shows that even on the sea coast the monthly means for July and January differ by 41° , while at Greenwich the corresponding difference is 25° or not much more than half. This variability comes out even more markedly in the table of extremes, where among the maxima there are several between 100° and 104° , and the mildest minimum is -7° or 39° below freezing.

The author has been persevering and fortunate in hunting up much collateral information, which not only checks the meteorological records, but makes the paper most interesting. For instance, on p. 345, he gives the earliest and latest frost of each year, from 1865 to 1887, the records being based not upon thermometers, but upon damage to tender plants. The values are—

Last in Spring.	Earliest in Autumn.	Duration of Season.
Earliest, April 9.	October 5.	Longest, 203 days.
Average, April 25.	October 22.	Average, 180 „
Latest, May 15.	November 8.	Shortest, 143 „

On pages 413 to 416, we have a list of the dates of the opening and closing of the Hudson river at Albany, for every year from 1789 to 1888, and shorter lists are given for the Delaware river and for two canals.

There is but one table which we miss, viz., one of the yearly totals of rainfall at each station, so that we might have had some information as to its fluctuation from year to year. Mr. Smock gives us a pretty looking table of mean monthly rainfall at 74 stations, but, as he himself partly hints, it is very unsatisfactory, some of the means (?) being based upon only *one* year—while perhaps the very next line of figures embodies the valuable result of twenty or thirty years' work. If the short period observations had been omitted, the table would have been half the size, and incomparably better.

Among the many interesting features of the book, we had nearly forgotten to mention a list of chronological notes on the weather from 1607 to 1887.

ANCHOR ICE.

To the Editor of the Meteorological Magazine.

SIR,—Seeing in your last number the question about “Anchor” or “Ground Ice” mentioned, I thought you might like to see a short paper I wrote on the subject. Anchor ice often occurs in great quantities in the river Ouse, and in the year 1887 was very marked, more particularly as to the great quantity of débris brought from the river bottom, and carried often a long distance, a heavy striking hammer, lost when a bridge was making over the river was brought up, as well as heavy stones, bricks, coals, chains, knives, pottery, the zebra mussel (*dreissena polymorpha*) in great quantities, bones, &c. As our river is thick when in flood, as was the case in point, I do not think that radiation has much, if anything, to do with it; still I should not like to say it has not, when others, wiser than myself, think it is one of the factors when “Anchor ice” is formed.

Yours truly,

JOHN BROWN.

Earlith, near St. Ives, Hunts., 19th March, 1889.

[We are glad of the opportunity of laying Mr. Brown's excellent paper before our readers. It seems to us that his stricture on the radiation theory has considerable weight].—ED. *M.M.*

ANCHOR ICE.

It will help in the explanation of this phenomenon if we consider what crystallization is, and how surface ice is formed. Crystallization is the spontaneous collecting or grouping together of certain regular forms known as crystals when fluids assume the solid state. This can take place only under certain favourable conditions, the principal of which are temperature, chemical action, electricity, evaporation, and the presence of suitable points for the crystals to form upon. The conditions under which water will form into ice crystals are these:—The water must be cooled down to 32° Fahr., freezing point; there must also exist some starting points for the crystals to form upon and aggregate round each other. Surface ice is formed upon rivers, ponds, and lakes when the water on the surface has been cooled down to 32° Fahr. This has been promoted by the body of the water having been cooled below 39° Fahr. by the law of circulation which always asserts itself when there exists a difference of temperature in the same fluid. The water on the surface having been cooled by contact with the frosty air, sinks down, its place being taken by a stratum of water of higher temperature. Which in its turn is in like manner cooled and sinks; the process is thus repeated, until a uniform temperature is produced 39° Fahr. At this temperature water having acquired its greatest density, the action of the law of circulation is reversed, the coldest water being now the lightest is found at the surface.

The ice crystals then begin to form, using the edges of the river

pond, or lake, as their necessary starting points ; from which, veins of crystals are seen to shoot out resembling the back of a leaf ; upon these veins more crystals form, filling in from vein to vein, the surface is thus rapidly covered. The crystallization is now continued on the underside adding thickness to the ice as long as the same conditions are maintained. The veins described are well seen in what is usually known as cat's ice. Surface ice, when formed upon running water, is formed in the same way as upon ponds or other still waters, but as the tendency of running water is to retard the formation of ice crystals, and also to disperse them when formed, it requires more frost before the ice crystals can form with sufficient rapidity to overcome these unfavourable conditions and spread over the surface. As a rule when rivers in this country are above their usual height the current is too strong for them to get frozen over. It is only when the water is at, or below, its normal height that surface ice is formed upon them.

The formation of anchor ice can take place only in running water, when the thermometer is below the freezing point ; and the phenomenon may be thus explained. Independently of the circulation already described arising from difference of temperature, but acting in conjunction with it, is the mechanical circulation of running water ; this dual, yet combined, action leads to the entire mass of water being cooled down to 32 deg. Fahr. This point of temperature being reached, the ice crystals, obedient to law, begin to form. But the current being too strong for them to do this upon the surface as upon still water, the asperities at the bottom (where the current is less rapid), supply the needed starting points round which the ice crystals rapidly group themselves. These asperities consist of stones, weeds, broken vessels, bricks, coal, shells, sticks &c. The cooling down of the water of a river to 32 deg. Fahr. by circulation is not the only effect produced ; the asperities at the bottom are in like manner cooled down by the refrigerated water running over them, abstracting such heat as may be in excess of 32 deg. Fahr., reducing them to this temperature, and thus conducing to the formation of the ice crystals upon them. After the ice crystals have thus formed in masses, and when these masses, augmented by more ice crystals, have gained sufficient buoyancy to lift the substances to which they are attached, they rise to the surface, bringing with them the weeds, stones, coal, bricks, &c., round which they have grouped themselves. These masses of anchor ice are not firm and solid like surface ice, being a collection of ice crystals somewhat loosely bonded together. It is only after having formed into a larger mass on the surface, or collected into a sheet of drift ice, that it assumes the hard and compact nature of ordinary ice, having always a very rough surface. The lifting of heavy substances by anchor ice is not so difficult as it first appears. Ice having a less specific gravity than water does, as we know, float, and it has a lifting power equal to the difference between the weight of a

given quantity of ice and of the water displaced by it. From the fact that the stones, shells, and other substances are in water, all there is to be raised by the ice when lifting these substances is the difference of the weight between the substance lifted and an equal bulk of water, and not the gross weight.

The temperature of running water when anchor ice is forming has been made a matter of experiment here. The result was found to be 32° Fahr. from the bottom of the river to the top. This year a large quantity of anchor ice has formed in the river Ouse, and was seen floating down for several days together, until in some places the river became quite blocked with it. As it melts where left upon the banks, it leaves quantities of *débris* brought from the bottom of the river, sometimes bringing to light interesting relics of bygone times.*

J. B.

Earith, January, 1887.

ROOKS AS WEATHER INDICATORS.

To the Editor of the Meteorological Magazine.

SIR,—If it please you to insert this letter in a future issue of your *Meteorological Magazine*, it gives you another sure indicator of weather.

In bright, fine weather we may often notice the rooks whirling in circles at a great height in the air, from which height (upwards of $\frac{1}{2}$ mile sometimes), they will pitch down at a great pace one after another, as if they would fall on the ground, and kill themselves. But no: rooks are wise birds, and never do anything without *cause*; it is merely a little game of their own (called "break-neck" in these parts), in which they indulge whilst the weather is fine; for no doubt they know full well that *in three or four days* there will be stormy weather, which surely enough comes to pass in the district, and generally in the place. On March 3rd, I noticed the rooks at this break-neck game, and pointed it out to a neighbour with whom I was, remarking, "See if we do not have stormy weather in a few days." On the following Thursday and Friday, 7th and 8th, we had 2·79 in. of rainfall in 41 hours as the rook-prophetic fulfilment.—Yours faithfully,

E. N. POCHIN.

Barkby Vicarage, Leicester, March 12th, 1889.

* "Sinkers" or stones with holes bored in them, formerly used by fishermen for weighting their nets; also Roman pottery.

GERMAN METEOROLOGICAL SOCIETY.

This society met at Berlin on March 12th, Prof. von Bezold, president, in the chair.—Dr. Wagner spoke on the connection between cosmic and meteorological phenomena. After a short review of the earlier attempts to connect meteorological phenomena with the rotation of the sun or with the phases of the moon, he passed on to a consideration of Prof. von Bezold's recently published work, in which it is shown that the storms in Bavaria and Würtemberg have a distinctly recurrent periodicity of 26 days, corresponding to the period (25·84 days) of the sun's rotation. In opposition to this, Köppen had found from his own calculations, based on more extensive data, that the storms are recurrent with a periodicity of 29 and not 26 days, thus corresponding to the synodical period of the moon. The speaker himself had investigated the periodicity of storms, not only in Bavaria and Würtemberg, but also in Baden, keeping the observations of lightning separate from those of mere rain-storms; this seemed to be necessary, not only inasmuch as von Bezold did not take any account of lightning, but also because the occurrence of lightning at the time of new moon, or during the last quarter of the moon, might give rise to apparent maxima resulting from purely optical causes. He found that the storms possess a periodicity of 29 days, which include three maxima, the chief of these being in the last half-quarter, the next at new moon, and the least at full moon. No physical explanation, or even any idea of any connection between the storms and the phases of the moon, can at present be given.—Dr. Assmann gave an account of a phenomenon which had been observed on the trees in the Thiergarten as a result of the recent heavy snow-fall. The masses of snow which were piled up high on the branches of the trees had slipped down round their sides and hung down like curtains; they possessed a not inconsiderable consistency and glacier-like structure. The superficial thawing which occurred daily about midday had contributed largely to bring about the modification which the snow had undergone.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, March 20th, at the Institution of Civil Engineers, Dr. W. Marcet, F.R.S., President, in the Chair.

Messrs. A. J. Hands, F.S.A., J. Jackson, S. A. Jones, J. E. Middlehurst, and L. Sutton, F.R.G.S., were elected Fellows of the Society.

Dr. Marcet delivered an address on "The Sun—its Heat and Light," in which he explained the composite nature of the solar beam, and the modifications which it undergoes in passing through

our atmosphere. He thus laid the foundation for subsequent remarks on the fine collection of Actinometers and Sunshine Recorders which the Society had collected for its exhibition.

The meeting was then adjourned in order to afford the Fellows and their friends an opportunity of inspecting the exhibition which was devoted principally to Actinometers, Solar Radiation Apparatus, and Sunshine Recorders, but included several new instruments, and many photographs of meteorological interest.

Among the instruments shown for ascertaining the absolute heating effect of the sun's rays, were Herschel's, Hodgkinson's, and Stewart's Actinometers, Pouillet's and Angstrom's Pyrheliometers, and Secchi's Solar Intensity Apparatus. There were also Luvini's Dietherscope for observing optically the changes of atmospheric refraction, Bellani's Lucimeter as used in Italy, and Crookes' Radiometer, in which the arms rotate with more or less velocity under the action of radiation.

An interesting collection of Sunshine Recorders also was exhibited, among which were the Campbell-Stokes and Whipple-Casella burning Recorders, and the Jordan and McLeod Photographic Recorders.

Several new Barometers, Anemometers, Nephoscopes, &c., also were shown, as well as the stephanome, which is used at the Ben Nevis Observatory for measuring the angular size of halos, fog-bows and glories.

Mr. Clayden showed an ingenious working model of the Atlantic Ocean, illustrating the formation of ocean currents in general, and of the Gulf Stream in particular. Models of very large hailstones, 7 inches in circumference, which fell near Montereau, France, on August 15th last, were also exhibited.

The exhibition included a very interesting collection of photographs of flashes of lightning, of clouds taken in various parts of the world, and of views taken on the summit of Ben Nevis.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPTEMBER, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth. inches	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	72·7	15	42·4	1	65·2	50·0	50·1	80	116·3	36·3	1·43	14	6·0
Malta	91·1	9	64·0	30	84·0	69·7	67·9	76	143·3	57·2	·63	2	2·6
Cape of Good Hope. ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	79·5	12	60·4	6, 13, 27	75·8	64·1	59·4	72	128·6	52·7	1·03	16	5·9
Calcutta	91·3	15	75·2	18	87·7	77·8	77·0	80	159·0	72·9	9·97	16	6·5
Bombay	86·8	18	74·8	12	85·8	77·2	75·0	80	144·3	70·2	4·92	14	5·6
Ceylon, Colombo	87·2	15	73·8	21	86·0	76·4	71·2	78	147·0	70·0	3·26	16	6·0
Melbourne	80·1	14	34·4	5	62·5	45·8	46·0	75	128·8	28·1	1·28	8	6·1
Adelaide	84·7	18	38·7	5	69·3	50·1	46·8	62	139·8	31·9	1·19	13	5·7
Wellington	64·0	29	37·0	7, 14	57·5	44·6	43·7	72	121·0	28·0	1·81	10	3·6
Auckland	67·0	30	40·0	13	59·8	47·5	45·8	75	135·0	36·0	·91	10	6·5
Jamaica, Kingston	93·3	16	70·6	5	90·1	73·2	74·3	78	...	...	6·67	...	...
Barbados	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	77·6	9	32·1	30	65·7	47·6	49·5	78	...	25·0	3·29	14	4·4
New Brunswick, (Fredericton	75·8	25	30·0	30	63·3	44·7	49·0	80	...	...	4·44	15	6·4
Manitoba, Winnipeg ...	82·8	2	23·3	12	66·7	41·2	45·7	77	...	...	1·53	14	4·7
British Columbia, (Victoria	79·0	1	38·0	10	69·0	45·2	...	...	...	...	1·01	7	...

REMARKS, SEPTEMBER, 1888.

MALTA.—Mean temp. 76°·0; mean hourly velocity of wind 6·7 miles. Sea temp. nearly stationary at 78°·9. TS on 18th. L on 19th, 27th, and 28th. Wind velocity much below average. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, of dew point 0°·1, and E ·54 in. below their respective averages. Mean hourly velocity of wind 10·3 miles, or 1·7 below average; extremes 24·6 on 1st and 2·2 on 6th and 13th. Prevailing direction, S.E. by E. to E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·0, of dew point 2°·4 and humidity 4 above the average; mean amount of cloud same as 30 years' average; E 1·03 in. below average. Prevailing winds N. and S.; strong on 8 days. Heavy dew on 5 days. Hoar frost on 9th. Fogs on 2 days; L on 3 days. Lunar rainbows on 21st and 22nd. R. L. J. ELLERY, F.R.S.

Adelaide.—Remarkably Warm. Mean temp. nearly 3° above the average of 31 years. Unusually long spell of warm weather in the middle of the month. E two-thirds of the average. C. TODD.

Wellington.—Fine, with a small rainfall. Prevailing wind N.W. and moderate, except fresh on 3 days, hail squalls on 11th and 12th. Earthquakes on 1st and 5th. R. B. GORE.

Auckland.—An unusually fine and dry month, the R being less than one-third of the average and the smallest ever recorded in September. Mean temp. slightly below average, barometric pressure considerably above. T. F. CHEESEMAN.

VICTORIA.—A lovely month, with very little fog.

SUPPLEMENTARY TABLE OF RAINFALL,
MARCH, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	2.89	XI.	Castle Malgwyn	2.72
	Margate, Birchington...	1.24	"	Rhayader, Nantgwillt..	4.82
"	Littlehampton	1.46	"	Carno, Tybrith ...	3.96
"	Haileham	1.70	"	Corwen, Rhug	2.29
"	Ryde, Thornbrough	2.35	"	Port Madoc	4.04
"	Alton, Ashdell	3.13	"	I. of Man, Douglas	2.36
III.	Oxford, Magdalen Col...	1.69	XII.	Stoneykirk, Ardwell Ho.	2.94
"	Banbury, Bloxham	2.69	"	New Galloway, Glenlee	3.25
"	Northampton	2.09	"	Melrose, Abbey Gate...	2.50
"	Cambridge, Beech Ho...	1.12	XIII.	N. Rak Res. [Penicuik]	2.45
"	Wisbech, Bank House..	1.81	XIV.	Ballantrae, Glendrisaig	2.54
IV.	Southend	.93	"	Glasgow, Queen's Park.	1.26
"	Harlow, Sheering	1.41	XV.	Islay, Gruinart School..	2.73
"	Rendlesham Hall	.62	XVI.	Dollar	.83
"	Diss	1.33	"	St. Andrews, Pilmour Cot	1.47
"	Swaffham	1.10	"	Balquhider, Stronvar..	2.77
V.	Salisbury, Alderbury...	2.11	"	Dunkeld, Inver Braan..	1.59
"	Warminster	2.82	"	Dalnaspidal H.R.S. ...	3.22
"	Bishop's Cannings	2.42	XVII.	Keith H.R.S.	1.96
"	Ashburton, Holne Vic...	7.37	"	Forres H.R.S.	1.10
"	Hatherleigh, Winsford.	3.01	XVIII.	Strome Ferry H.R.S....	6.22
"	Lynmouth, Glenthorne.	4.31	"	Fearn, Lower Pitkerrie.	1.19
"	Probus, Lamellyn	4.45	"	Loch Shiel, Glenaladale	9.77
"	Launceston, S. Petherwin	3.88	"	N. Uist, Loch Maddy ...	3.33
"	Wincanton, Stowell Rec.	2.48	"	Invergarry	4.14
"	Taunton, Lydeard Ho...	4.75	"	Loch Ness, Drumnadrochit	2.44
"	Wells, Westbury	3.59	XIX.	Lairg H.R.S.	3.22
VI.	Bristol, Clifton	4.38	"	Forsinard H.R.S.	1.68
"	Ross	3.28	"	Watten H.R.S.	1.68
"	Wem, Clive Vicarage ..	2.51	XX.	Dunmanway, Coolkelure	3.77
"	Cheadle, The Heath Ho.	3.31	"	Fermoy, Gas Works ...	1.32
"	Worcester, Diglis Lock	2.61	"	Tipperary, Henry Street	1.04
"	Coventry, Coundon	4.05	"	Limerick, Kilcorran ...	1.41
VII.	Ketton Hall [Stamford]	2.36	"	Miltown Malbay	2.00
"	Grantham, Stainby	2.48	XXI.	Gorey, Courtown House	1.08
"	Horncastle, Bucknall ...	2.89	"	Navan, Balrath	1.90
"	Mansfield, St. John's St.	4.08	"	Mullingar, Belvedere ...	1.92
VIII.	Neston, Hinderton	2.36	"	Athlone, Twyford	2.11
"	Knutsford, Heathside ...	3.30	"	Longford, Currygrane...	1.66
"	Lancaster, South Road.	3.00	XXII.	Galway, Queen's Coll...	1.51
"	Broughton-in-Furness ...	4.33	"	Clifden, Kylesmore	5.58
IX.	Wakefield Prison	3.16	"	Crossmolina, Enniscoe..	2.50
"	Ripon, Mickley	2.93	"	Collooney, Markree Obs.	2.39
"	Scarborough, West Bank	2.37	"	Ballinamore, Lawderdale	1.80
"	East Layton [Darlington]	2.08	XXIII.	Warrenpoint	3.09
"	Middleton, Mickleton ..	1.73	"	Seaford	4.07
X.	Haltwhistle, Unthank..	2.62	"	Belfast, New Barnsley..	3.48
"	Shap, Copy Hill	2.67	"	Bushmills, Dundarave...	2.28
XI.	Llanfrechfa Grange	4.53	"	Stewartstown	1.38
"	Llandovery	3.66	"	Buncrana	2.71

MARCH, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which 1 or more fell.	TEMPERATURE				No. of Nights below 32° On spring.	
		Total Fall.	Difference from average, 1870-9	Greatest Fall in 24 hours.		Max.		Min.					
				Inches.	Deg.			Date.	Deg.	Date.			
I.	ENGLAND.	London (Camden Square) ...	1.36	—	.25	37	7	13	59.6	24	19.2	4	12 21
II.		Maidstone (Hunton Court)...	1.85	+	.27	.55	7	15	...	...	...	...	...
III.		Strathfield Turgiss	1.91	+	.51	.33	7	17	62.3	29	20.4	4	15 23
III.		Hitchin	1.40	—	.08	.32	20	13	59.0	24 ^b	16.0	3	14 ...
IV.		Winalow (Addington)	1.95	+	.19	.38	19	11	63.0	24	18.0	4	15 20
IV.		Bury St. Edmunds (Culford) ...	1.71	+	.15	.62	8	6	50.0	13 ^c	10.0	3, 4	17 ...
V.		Norwich (Cossey)	.83	—	.86	.40	7	7	63.0	25	12.0	5	4 13
V.		Weymouth (Langton Herring) ...	1.57	—	...	.60	6	14	59.0	29	25.0	2	12 ...
"		Barnstaple	3.43	+	.94	1.00	8	13	54.0	14	26.0	2	...
"		Bodmin	5.50	+	2.34	1.92	4	18	53.0	29	25.0	2	9 14
VI.	ENGLAND.	Stroud (Upfield)	4.80	+	2.99	2.10	8	16	60.0	24 ^b	25.0	4, 15	16 ...
"		Churchstretton (Woolstaston) ...	2.37	+	.21	1.01	8	16	59.0	29	22.5	4	16 19
"		Tenbury (Orleton)	2.80	+	.93	1.14	8	18	63.5	29	21.7	4	13 18
VII.		Leicester (Barkby)	4.08	+	2.81	1.94	8	14	63.0	29	15.0	3	17 22
"		Boston	2.03	+	.74	.68	7	12	64.0	24	24.0	4	12 ...
"		Healey Hall [Tickhill]	3.47	—	...	1.40	8	11	62.0	24	19.0	4	12 ...
VIII.		Manchester (Ardwick)	2.64	+	.19	.90	8	14	64.0	24	34.0	4	0 ...
IX.		Wetherby (Ribston Hall)	1.35	—	.78	.54	21	7	...	...	...	...	...
"		Skipton (Arnccliffe)	5.70	+	.94	1.27	24	17	...	...	...	...	...
"		Hull (People's Park)	2.33	+	.52	1.35	8	16	...	...	...	...	...
X.	WALES.	North Shields	2.57	+	1.12	.90	19	15	61.5	24	11.5	4	15 19
XI.		Borrowdale (Seathwaite)	8.88	+	1.01	2.70	24	19	...	...	...	...	...
"		Cardiff (Ely)	3.85	+	1.16	.97	7	15	...	...	...	...	...
"		Haverfordwest	2.29	—	.90	.26	23	18	54.8	24	24.0	2	9 20
"		Plinlimmon (Cwmsymlog)	5.23	—	...	1.07	23	15	...	...	...	...	...
XII.		Llandudno	1.72	—	.16	.76	19	18	51.5	25	25.5	4, 5	5 ...
XII.		Cargen [Dumfries]	3.12	+	.34	1.78	6	11	55.8	16	19.0	4	15 ...
XIV.		Jedburgh (Sunnyside)	2.83	+	1.26	.93	19	9	55.0	29	19.0	4	15 ...
XV.		Old Cumnock	2.56	—	.37	.50	24	19	53.0	29	15.0	2	14 ...
XV.		Lochgilphead (Kilmory)	2.78	—	1.83	.48	23	20	...	...	...	...	...
"	SCOTLAND.	Oban (Craigvarren)	3.97	—	...	.92	23	23	53.0	24	25.6	3	8 ...
"		Mull (Quinish)	4.04	—	...	1.10	7	14	...	...	...	...	...
XVI.		Loch Leven Sluices	1.40	—	.72	.30	7, 18	9	...	...	...	...	...
XVII.		Dundee (Eastern Necropolis) ...	1.70	—	.06	.65	2	11	60.6	24	19.4	4	13 ...
XVII.		Braemar	.99	—	1.20	.20	18	17	60.0	28	8.0	2	16 24
VII		Aberdeen (Cranford)	2.35	—	...	.57	19	20	64.0	24	8.0	4	11 ...
VII		Lochbroom	4.40	—	...	.61	23	26	...	...	...	...	...
"		Culloden	1.12	—	.63	...	...	...	57.0	24 ^d	20.0	4	8 21
XIX.		Dunrobin	1.68	—	...	.36	19	11	59.8	29	25.0	2	13 ...
"		S. Ronaldsay (Roseberry)	2.41	+	.26	.39	12	23	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	1.64	—	1.12	.44	3	10	61.0	14	27.0	4, 9	10 ...
"		Dromore Castle	3.78	—	...	.60	23 ^a	14	64.0	15	29.0	3	...
"		Waterford (Brook Lodge)	1.33	—	...	.42	18	18	59.0	13	25.0	10	11 ...
"		O'Brien's Bridge (Ross)	2.04	—	...	.68	6	14	60.0	28 ^b	26.0	11	7 ...
XXI.		Carlow (Browne's Hill)	1.23	—	.88	.47	18	15	...	...	...	...	...
XXII.		Dublin (Fitz William Square) ...	1.08	—	.65	.38	19	17	58.3	28	31.0	3	5 14
XXII.		Ballinasloe	1.97	—	.41	.53	6	16	54.0	29	22.0	2	15 ...
XXIII.		Waringstown	2.38	+	.32	.55	27	20	58.0	29	25.0	1	11 14
"		Londonderry (Creggan Res.)	2.87	—	...	.84	27	23	...	...	...	...	...
"		Omagh (Edenfel)	2.31	+	.22	.58	19	22	53.0	14 ^d	27.0	1	10 14

a And 24. b And 29. c And 24, 25. d And 28, 29.

+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was generally cloudy and unsettled, with temp. below the average. A good deal of rain fell locally, with H on 31st. Towards the end of the month there was a considerable depression of the bar., with strong winds from N.W. Snowdrops in flower on 1st; blackbird's nest and eggs found on the 17th; thrush's nest and eggs on the 22nd.

HITCHIN.—One of the driest quarters ever experienced; after two very dry years.

WINSLOW, ADDINGTON.—Frosts frequent during the month, very sharp on the 3rd and 4th; from 19th to 21st stormy, with pressure at 9 a.m. on the 20th 28·919 in. (corr.) Altogether a favourable time for the land, which was in capital order for receiving seeds.

WEYMOUTH, LANGTON HERRING.—R 29 in. below the average; mean temp. (41°·3) 0°·3 below the average. There was a heavy storm on 8th, preceded by a foggy day. The wind was high on 26th, and on 29th the weather was sultry and thundery.

BODMIN.—A very genial month. Mean temp. 41°·2.

WOOLSTASTON.—The month opened with 12 days of very severe weather, S falling on the 1st, 3rd, 7th, and 8th; on the latter day there was an even fall 1 ft. deep, which broke down the trees in all directions. The latter half of the month was warmer, though S fell on 20th and there were many severe frosts at night. Mean temp. 38°·9.

ORLETON.—The first 12 days were cold and frosty, with a temp. 5° below the average, frost every night and frequent light falls of S. S mixed with R set in before 6 a.m. on the 7th and continued till 10 p.m. on the 8th, and during this time the ground was covered with wet snow often 2 inches deep, but on the hills it was more than 12 inches deep. The S melted gradually on the hills and the river was not flooded, though 1·79 in. was measured in the rain gauge for the two days. The remainder of the month was variable, with several severe frosts at night and a few warm days. Pressure variable, but generally high. Prevailing wind N., frequently very rough. Mean temp. 0°·3 below the average of 28 years.

BARKBY.—Great floods on the 8th. Mean temp. 40°·3.

ARDWICK, MANCHESTER.—This month was fairly mild, with a few bright spring days. Very dark and stormy on 20th. S fell on 8th, but did not remain on the ground more than a few hours.

HULL.—The weather during the first eight days was cold, with frequent showers of H, sleet, S and R, sometimes with mist or fog; from that date to the 18th fine weather prevailed generally, with light clouds, but from the 18th to the end it was showery, and sometimes stormy.

WALES.

HAVERFORDWEST.—The month commenced with severe weather, S and violent winds from N.N.E. to E.; it continued very cold up to the 11th, with S on the ground for some days, and the Precelly range white. Changeable, wet and cold weather prevailed throughout the remainder of the month, though in the last week it improved a little. Mean temp. about the average.

SCOTLAND.

CARGEN.—The first 11 days were unusually cold, and considerably more than half the total E of the month fell on the 6th.

JEDBURGH.—The weather was generally dry, but cold and ungenial, with low temp. at night, and keen winds, which kept the soil dry for seed sowing. Spring flowers in bloom. S on 19th, 20th, and 21st.

LOCHBROOM.—An unusually open month, with very little S and no frost, but a good deal of warm weather, with almost constant mild E or showers. A splendid month for the farmers.

ROXBERRY.—From the 1st to the 5th, S storms, afterwards rough and squally weather generally. Winds mostly from S.W. to N.

IRELAND.

CORK.—Generally fine and often bright. T on 11th, with a slight fall of H.

DROMORE.—A very fine month, and vegetation made fair progress. Spring work well advanced.

WATERFORD.—E 1.59 in. below the average. S on 1st and 2nd; H on 30th and 31st. Mean temp. 42°·9.

ROSS, O'BRIENSBRIDGE.—A most favourable month for agricultural work. Some sharp frosts, but no excessive cold or violent wind; more than the average amount of sunshine, and no fog.

DUBLIN.—A moderately favourable month, with N.W. and W. winds. The beginning of the month was cold, but genial weather was experienced from time to time. Fogs on four days; high winds on nine days; gales on four days; S or sleet on two days; H on five days.

OMAGH EDENFEL.—The month had but few characteristics of March. Hardly any E. wind, and but the sign of S on one occasion. The absence of drying winds, with a E more persistent than heavy, occasioned a late seed time, but vegetation was otherwise in advance of the average.

PRACTICAL USE OF THE EARTH'S INTERNAL HEAT.

According to the *American Meteorological Journal* an attempt is about to be made at St. Augustine, Flo., to sink a 12-inch artesian well to a depth sufficient to obtain water hot enough to heat buildings, pure enough for domestic purposes, and with pressure enough to run heavy machinery. Water can be found in Florida by boring 250 feet; and it is known that the artesian wells in that State have considerable pressure, and from a depth of 600 feet send water of warm temperature to a height of 45 feet when piped. The earth's internal heat is already forced into practical service at Pesh, where the deepest artesian well in the world is being sunk to supply hot water for public baths and other purposes. This well supplies daily 176,000 gallons of water heated to 158 deg. Fahrenheit, and the boring is to be continued until the temperature of the water is raised to 176 deg. Heavy machinery is run by artesian well power in many parts of France, and the experience of the French shows that the deeper the well the greater the pressure and the higher the temperature. At Grenelle, a well sunk to the depth of 1802 feet, and flowing daily 500,000 gallons, has a pressure of 60 lbs. to the square inch, and the water from this well is so hot that it is used for heating the hospitals in the vicinity.

—*Nature.*

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXX.]

MAY, 1889.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

METEOROLOGICAL BIBLIOGRAPHY.*

FOR the first time in history, the Congress of the United States has been stingy. Hitherto that great country has been conspicuous for greater excellence in its official publications, and for greater liberality in distributing them, than any country in the world. But for some reason, of which we on this side of the Atlantic know nothing, General Greely has been refused authority to print the Bibliography which meteorologists throughout the world are waiting for.

Probably in this case (as in other countries), those who have been elected to Congress do not understand the details of scientific work, and think that they are stopping a waste of money by refusing to order the printing to be undertaken. We know that the contrary is the truth; and that nothing will tend more towards assuring that every dollar expended upon meteorology will obtain a dollar's worth of progress, than the publication of this work. Perhaps it may be well to give a homely illustration from the last few numbers of this magazine. In the March number appeared a letter upon the subject of Anchor Ice. We turned up such notices of it as we remembered, or could find, but there were but four, and a fifth was given in the April number. But on turning to the work now before us, we find four quarto pages of titles of papers upon the subject—the total number being not five, but sixty-two. Let some one read up these sixty-two memoirs, work them into a single monograph, and the whole subject will probably be completely elucidated and disposed of, so that further time need never be spent upon it.

We cannot believe that Congress will, when the subject is clearly

* BIBLIOGRAPHY OF METEOROLOGY.—A classed catalogue of the printed literature of meteorology from the origin of printing to the close of 1881; with a Supplement to the close of 1887, and an Author Index. Prepared under the direction of General Greely, edited by Oliver L. Fassig, Bibliographer and Librarian, Signal Office. Part I., Temperature. Washington Signal Office, 1889, 4to, 381 pages.

placed before it, refuse to do that which (1) it, by its officer,* undertook to do, and (2) which would confer a benefit not only upon their own Signal service, but on every meteorological organization in the world.

Still, we all know that good comes out of evil; and this obstruction has compelled General Greely, for the needs of his own office, to get the material into shape; and he seems to have produced the invaluable work before us by a type writer with lithographic ink, and he has been good enough to pull a few extra copies and send them to some of those who, about seven years ago, did what they could to help the Signal office when under the direction of his predecessor.

This volume deals with only one subject, Temperature, yet it contains about 5,000 entries of separate books and papers, or about one-tenth of the whole bibliography. The sub-division was originally arranged by Dr. Lancaster, of Brussels, and subsequently modified by Mr. Sawyer, the former librarian of the Signal Office. It is so good, and will give so thorough an indication of the character of the work, that we print it, and against each heading the number of pages occupied by the titles in each section.

Temperature in general	12	Vertical distribution of temperature	18
Solar radiation	28	Horizontal distribution of temperature	38
Terrestrial radiation	8	Temperature of the earth	44
Periodic variations of temperature	22	Temperature of the ocean	36
Non-periodic variations of temperature—		Temperature of lakes and rivers	12
(a) General questions	14	Temperature of springs	7
(b) Annual temperature	16	Ground ice.....	4
(c) Fall and winter temperature	39	Calculation of mean temperature	2
(d) Spring temperature	8	Temperature of space	1
(e) Summer temperature	12	Index to authors	55
(f) Frosts	6		

As specimens of the entries, we give the first, and the last of the first section.

Redi F. Della natura del caldo e del freddo lettera. 2 ed. 4to, Firenze, 1590.

Influence des forêts sur la température de l'air et du sol. *Ciel et terre*, Brux. III., 1887-88, 149, 151.

We said that good had come out of evil; and it is in this way:—Those of us who can spare time can treat these copies as proofs, and mark down every imperfection and addition, and then when Congress eventually realizes the position and authorizes the final printing, if

* Extract from letter dated November 4th, 1881, addressed by General Hazen, Chief Signal Officer to Mr. G. J. Symons:—"The great advantage to all interested in meteorology that would result from having a complete bibliography of the literature of this subject is acknowledged on all sides, and I shall be pleased to accept your offer, and will print, with full recognition, the card catalogue of 20,000 titles already compiled by you, in connection with that compiled by Professor Abbe."

these copies be returned to Washington, and all the notes be incorporated, the final work will be far better than it would have been without; and though many of us sadly grudge the years we have had to wait, future generations will profit by our loss.

MR. WHIPPLE ON LIGHTNING PHOTOGRAPHS.

At a recent meeting of the Physical Society, Mr. Whipple read a paper in which he dealt with two of the many interesting questions, raised by the rapidly spreading practice of photographing lightning. The paper and the discussion were reported in *Industries* as follows:

THE DARK FLASH SEEN IN SOME LIGHTNING PHOTOGRAPHS.

The author referred to the fact that some two years ago the Meteorological Society issued a circular asking for photographs of lightning flashes, and in reply to this circular a large number were received from different parts of the world, but chiefly from France and Belgium. Prints from these photographs have been pretty widely distributed, and have attracted a great deal of attention. Our readers may remember that much interest was excited by the ribbon-like character of the markings observed in the photographs of some of the flashes, and still more by the so-called "dark flash," viz., a dark mark on the surface of the photograph, having all the characteristics of a lightning flash except in its being dark instead of light. Professor Stokes had suggested that the dark flash might be caused by one flash following exactly the same path as another immediately preceding it, and having some of its light cut off, more especially the highly refrangible rays, which would mainly affect the photographic plate, by having to traverse the nitrous oxide gas, formed by the decomposition of ammonia during the passage of the first flash. With respect to the ribbon markings, it occurred to the author that they might be due to the photographs having been taken through the glass of a window. He had not yet had the opportunity of testing this, by actually taking photographs of lightning flashes through interposed sheets of glass; but he had endeavoured to get an effect somewhat similar to that of a flash, by drawing a wavy chalk line on a black board, and photographing it after having previously interposed a sheet of plate or window glass slightly deviating from the plane perpendicular to the axis of the lens. These photographs, which were exhibited to the Society, showed a remarkable likeness to the ribbon markings observed in the photographs of the lightning flashes, and it seems probable that this may be the true explanation of them. It occurred to the author that the dark flash observed on some of the prints might have been due to a somewhat similar cause, viz., to internal reflection within the glass of the negative plate, and he pointed out how such an effect might be produced if the printing was effected by means of sunlight fall-

ing somewhat obliquely upon the negative. He had tried to test this by means of photographs of the chalk lines drawn upon the black board ; but he had been unable to make many experiments, owing to the recent weather having been unsuitable for printing. He showed, however, a photograph which exhibited, though not very perfectly, an effect of the kind.

In the course of the discussion which followed, Dr. Gladstone said that though he naturally hesitated to criticise anything that Professor Stokes had suggested as an explanation of an optical phenomenon, yet he found it very difficult to imagine that one flash should follow so exactly the same path as one which had just preceded it, and it also appeared difficult to believe that a sufficient quantity of nitrous oxide could be produced to show the observed effect. Some of the photographs which showed the dark flash very clearly had been taken by a Mr. Shepherd at Westbourne-grove, so that the negatives would probably be available, and an examination of them would decide between the two explanations ; for if Mr. Whipple's explanation was the true one, the dark flash would not be shown upon the negative.

Mr. Boys stated that he always made a point of observing a lightning flash whenever possible, and that he had often observed a series of flashes following immediately one after the other in exactly the same path, every turn and twist in one flash being observed in those which followed it, and the whole series occurring in a fraction of a second.

Since writing the above we hear that a writer in the *Bayswater Chronicle* says, speaking from personal knowledge, that the "ribbon" lightning photograph was taken in the open air, and not through a window, and that the dark flash is not a reversion of any other flash shown in the same plate. The only theory which so far explains the curious phenomenon, of a dark flash of lightning being seen amongst the ordinary white flashes in a photograph, seems to be that which has been offered by Prof. Stokes, F.R.S., and Prof. Curtis, of Harvard University. Both these authorities arrived independently at the conclusion that the dark flash shown is really the path of a dead flash—that is, a vanished flash which has left a track of heavy nitrous oxide gas behind it in the atmosphere, impervious to the light of the flashes immediately following, and thus appearing opaque in the picture. We understand that Prof. Stokes's suggestion for charging a camera in the daytime during a thunderstorm, and taking off the cap just after a flash has disappeared, will be adopted, inasmuch as according to the theory, a dead flash should certainly then record itself on the plate.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on the 17th ult., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. R. C. Mossman and Mr. E. H. Ryan-Tenison, M.R.C.S., were elected Fellows of the Society.

The following papers were read :—

1. "On the Deaths caused by Lightning in England and Wales from 1852 to 1880, as recorded in the returns of the Registrar-General," by Inspector-General R. Lawson, LL.D. The total number of deaths from lightning during the 29 years amounted to 546, of which 442 were of males, and 104 of females. In consequence of their greater exposure, the inhabitants of rural districts suffer more from lightning than those of towns. It appears also that proximity to the west and south coasts reduces the chances of injury by lightning, and that elevation and distance from the coast seem to increase them.

2. "The Diurnal Range of the Barometer in Great Britain and Ireland," by Mr. F. C. Bayard, F.R. Met.Soc. The author has reduced the hourly records of the barometer at the nine observatories, Aberdeen, Armagh, Bidston, Falmouth, Glasgow, Greenwich, Kew, Stonyhurst, and Valencia, during the years 1876-1880. The curves for inland places are smoother than those for places on the sea coast, and the curves for places to the westward and southward are more irregular than those for places to the eastward and northward.

3. "Note on a Working Model of the Gulf Stream," by Mr. A. W. Clayden, M.A., F.R. Met.Soc. The author showed this interesting model (which has been constructed to illustrate the formation of ocean currents in general, and of the Gulf Stream in particular) and explained how the currents were produced.

4. "On the Rime-frost of January 6th and 7th, 1889," by Mr. C. B. Plowright, F.L.S. The author sent an account of the very heavy rime which occurred in the neighbourhood of King's Lynn on the above days, when the fringe of crystals upon twigs and branches of trees was about two inches in length. The weight was so great that nearly all the telegraph wires were snapped, and many branches of trees were broken off.

LONDON FOG AND ITS EFFECTS ON PLANTS.

The Royal Horticultural Society has lately been giving much attention to the above subject, and has resolved upon collecting and publishing such information as may be forthcoming. This course has been resolved upon in accordance with a suggestion, made at the Scientific Committee's meeting by Mr. Thiselton Dyer, F.R.S., the Director of the Royal Gardens at Kew, who said that they had not much ground for complaint at Kew until the winter of 1887-1888.

The fog proved injurious in two ways. First, in forming an oily deposit of dirt which was left on all the glass houses. This was so thick, and of so intractable a character that every pane had to be washed by hand. The houses looked as if they had slate roofs instead of being glazed. The same result occurred in the winter of 1888-1889. Secondly, with regard to the injury to plants, it seemed out of all proportion to the nature of the fog, especially so on Orchids. Thus, *e.g.*, when a fog comes on, the inflorescence of species of *Phalænopsis* breaks up, and the flowers disarticulating fall off. Many plants suffer more or less, and especially such as have a more tender foliage. Mr. Dyer remarked that the young foliage of a *Carpenteria* growing on a south wall did not suffer, while another plant under glass, with possibly tenderer foliage, was severely injured. The fogs extended even as far as Dorking, for Sir Trevor Lawrence lost a large number of flowers in a few hours. Mr. Veitch remarked that he found injurious effects to follow the two kinds of fogs, those caused by London smoke, and the ordinary country white fogs. In the dull weather accompanying the latter, flowers would not expand properly, as was particularly the case with early varieties of *Lælia anceps*. The yellow fogs of London had been getting steadily worse for the last twenty years. Camellias frequently lost their buds, especially certain kinds, as double whites. A peculiar feature observed by Mr. Veitch was, that the fog seemed to gum up the buds at a certain stage of development, though either before or after that particular period of growth the buds were unaffected by the fog. He mentioned that 1000 flowers of *Cattleyas* were lost in three weeks.

THE PROPOSED BERMUDA-HALIFAX CABLE: ITS USEFULNESS FOR WEATHER PREDICTIONS.

The announcement made by the British Postmaster-General (says the *New York Herald*), that the Government intended to lay a submarine cable between Bermuda and Halifax, will be good news to all Atlantic seamen and all American and European meteorologists. Bermuda is a natural observatory for watching hurricanes emerging from the tropical ocean and threatening to assail the United States, or to advance north-eastwardly from the Gulf Stream into the transatlantic steamer tracks, and subsequently to burst upon the shores of Europe. Of course an observer at Bermuda cannot see with the naked eye what a Gulf Stream storm is doing, or determine by ocular demonstration what its course will be. But by watching the fluctuations of the barometer at this mid-Atlantic station, and by reporting them by cable to America and Europe, meteorologists on either continent will be enabled to feel the pulse of the storm and to determine more accurately its intensity and its future movements. For purposes of weather and storm forecasting in our Atlantic States, therefore, weather cablegrams from Bermuda will be invaluable.

REVIEWS.

Egeson's Weather System of Sunspot Causality, being original researches in solar and terrestrial meteorology. By CHARLES EGESON, Weather Map Compiler, Sydney Observatory, New South Wales. Turner and Henderson, Sydney, 1889. 8vo., ix., 63 pages. 5 folding plates.

IT is of course very rash for a reviewer to presume to question a dictum by Herbert Spencer, but we hold that the following lines from Chapter V. of the work before us are untrue, and are libellous of meteorology.

"Herbert Spencer has told us that the object of all science is to enable us to predict phenomena. Meteorology has no other object."

We do not produce arguments against these statements, because we believe that they will occur to every reader. But we have quoted these lines, because, although we cannot go the length which Mr. Egeson does, and say that meteorology has no other object than prediction, we desire to assure him that our strongest sympathies are with him, and with all who honestly try to detect the basis on which long period predictions can be established. We know that some leading British meteorologists have declared it to be impossible to predict more than a day or two in advance. If that were certain, and if Mr. Herbert Spencer's dictum were true, we suppose that every meteorological observatory ought to be dismantled. But it is not our view, we cling to the hope that, complex as is the problem, it will eventually be solved, therefore it is, that we have no sympathy with those who scoff at honest attempts to pierce the mystery, and that is why nothing would give us greater pleasure than to express our conviction that Mr. Egeson had proved his case, and that a triple sunspot, or 33 year, period was the solution of the whole question. There is one charm about Mr. Egeson's book, he has done what Fullbrook did in his *Wet and Dry Seasons in England*, carried his curves four years into the future, so that all can compare the forecasts with the facts.

Now that we are being told that Nebulae, if not also stars, are merely colliding meteors, we must not speak disrespectfully of them, but really we scarcely know how to believe that sunspots (large enough for a dozen worlds as large as the one we inhabit to be dropped through simultaneously and side by side), are produced by the impact of meteors. How many hundred millions would be required? Although the author quotes this theory, he seems to feel that it is hardly safe to trust to it, and so he wisely comes back to the sunspots themselves and leaves their production alone.

In such work as the author has here undertaken, the great danger is that of deceiving one's self. Every step in the process of investigation should be fixed rigorously; if not, one is sure to fall into the temptation of tossing in the direction one wishes, and a multitude of little tossings produces a sensible effect. We notice

two weaknesses of this kind on page 14, in the first and second line Mr. Egeson writes, "where seven days intervene, give three to one and four to the other indiscriminately." For "indiscriminately," he should have said "alternately." The other case is more complicated, the author has worked out, for what we may perhaps be permitted to describe as lunar weeks, their relative wetness and he gets the following values :—

1, 2, 5, 4, 3, 7, 3, 5, 2, 2, 0, 4, 2, 1, 1, 2, 1, 3, 0, then he says, "When projected, these give a better idea of mutual relation than their appearance here; but this must appear to every one, that the increase from 1 to 2 and 5 forms a rising slope, and the falling slope is represented by the figures 5, 4, 3. This I call a period. "The number 5 represents the maximum, and 1 and 3 are two minima. Thus the max. in the series are (5) 7, 5, 4, 2 and 3." The author has forgotten to insert in this little list the first max. of 5, so we put it in (). But we have a serious question to ask. Why do we find in the list of max. such very low values as 2 and 3? Within two lines we are told that "1 and 3 are the two minima," and that "the max. in the series are . . . 2 and 3."

A very similar series of anomalies occurs on page 44, where the author applies some curious method and picks out min. which are not min., and max. which are not max., because rather high or rather low values occur in the years in which his theory requires them. Considering that his book reached England early in April we may surely assume that it was printed not later than February 1889. Here then is a droll sentence.

"The extreme maxima of 1857 and 1888-90, representative of our local thirty-three year cycle, is (sic.) marked with double asterisks" — a double? would surely be more appropriate. April 1889 had not commenced when the book was printed, far less had April 1890. April 1888 had a high mean pressure, the highest since April 1857, but that was 31 years not 33, and that is the only explanation which occurs to us for the remarkable bracketing of prophetic values for 1889 and 1890, along with the real one in 1888, which seems to have come two years too soon.

By a mysterious process of which we cannot approve, Mr. Egeson evolves the depth of rain at Sydney, when there was no gauge, from the number of entries of rainy days, and jumps at values for Sydney by adding 10 (which he afterwards says should be 12) inches to each year at Parramatta (or Paramatta he spells it both ways). We say jumps because evidently the quantity to be added varies with the total; suppose the mean at Parramatta to be 36 in., and at Sydney 48, then when the Parramatta fall was 24, only 8 should be added, and when at Parramatta it was 48, the addition should be 16. And yet after this loose way of making up returns, Mr. Egeson has the assurance to write.

"This then ($45\frac{1}{2}$ in.) is Sydney's mean annual rainfall, and not

49½ in. as published in official returns, and deduced from the records since 1840."

The author has worked at his subject as only those work whose hearts are in it—but he is not methodical, and, therefore, has not afforded the demonstrations which perhaps he could. For instance the diagrams facing page 20 are most aggravating. We have four diagrams, one pair showing sunspot area for two years, and the other pair, rainfall for two years—but when one begins to compare them, one finds that the first pair are for 1882 and 1887, the other pair for 1887 and 1888.

Untersuchungen ueber die tägliche Oscillation des Barometers. VON J. HANN, W.M.K. Akad. [Excerpt "Denks. der Math. Naturwissen. classe der K. Akad."] Tempsky, Vienna, 1889, 4to., 73 pages.

THE interest taken in the small daily oscillations of the barometer is rather remarkable. It almost seems as if every meteorologist who reached the front rank felt it obligatory upon him to write a memoir upon the daily range of the barometer; indeed, Dr. Hann in this very paper remarks that the literature upon the subject is already sufficient to fill a small library. A short paper upon it, by Mr. Bayard, is mentioned on p. 53 of this number; another and elaborate investigation, by Dr. Buchan, is, we believe, in a forward state; in France, M. Angot has one either in MS. or in the printer's hands, but as the above title shows Dr. Hann is the first of the present group to have his paper completed and published.

It is evident that he who publishes first has an advantage and a disadvantage over his successors—an advantage in that he has priority for any discoveries that he may have made, a disadvantage in that those who come after can profit by his labours, and learn by his mistakes, if he makes any.

Until the American Government print their promised Meteorological catalogue, the labour of every worker in the subject is seriously impeded and injured. Dr. Hann has given the constants for about 120 stations, but we do not think that he has exhausted existing materials, and, much as we admire them, we should not have accepted the indications of Richard's and Höttinger's Barographs for such delicate work. Another matter in which we should have acted differently from Dr. Hann, is in accepting observations made during extremely short periods; out of the 100 in his principal table, there are 28 based upon one year or less, 10 of them being for less than four months. This to us seems hazardous, but Dr. Hann is not one to do things without good warrant, and therefore we do not venture to say that it is unwise. He has doubtless applied the very simple test of trying whether the two halves of these short records, when compared, give nearly identical values.

In considering the influence of altitude above sea level on the

amplitude of the barometric oscillations, Dr. Hann takes up also that of height above ground, and suggests that the Eiffel tower might be utilized for that purpose.

The whole work has been done with that thoroughness and care which characterize the author; he has contributed one more treatise to the existing small library, but one which no student of the subject can afford to ignore.

A List of the More Remarkable Earthquakes in Great Britain and Ireland during the Christian Era, compiled by WILLIAM ROPER, F.S.S., F.R.Met.Soc. Lancaster: T. Bell, 8vo, 46 pages.

It was our painful duty last year to include the name of our worthy Lancaster observer in the obituary in *British Rainfall*, a section which it is always saddening to prepare, and sometimes especially so when we know that the work of those who are taken from us will be abruptly stopped, no relative taking any interest in it. We had the pleasure during Mr. Roper's lifetime of calling attention to more than one privately printed paper issued by him, and we are glad to recognize in the pamphlet before us the best list of British Earthquakes, and a memorial to a Father's memory better, more useful, and more lasting than marble or granite. For good paper, as we all know, will stand for three or four hundred years without a sign of age—and this pamphlet must be secured for all libraries which pretend to completeness in physical geography, seismology, or geology—and with modern precautions against damp and against fire, we see no reason why the last copy should disappear for many hundred years to come, unless, indeed, the world itself should go also.

Mr. Roper has searched nearly all the old chroniclers, such as Matthew of Paris, Roger de Hoveden, William of Malmesbury, Florence of Worcester, several of the County Histories, O'Reilly's Catalogues in the *Trans. Roy. Irish Acad.*, Mallet's great Catalogue, Meldola's Report on the Essex Earthquake, the *Phil. Trans.*, *Annual Register*, *Gentleman's Magazine*, &c. And though, of course, neither he nor anyone else could sift the wheat of truth from the chaff of fiction, with which a thousand years since it was considered imperative to mingle every statement, still we believe that he has done all that can be done. Mr. W. O. Roper quite rightly points out that it is exceptionally difficult to avoid errors in such a work as this—but it may be well for us to mention something bearing on the other side of the question, viz., that in many works wrong dates are given, owing to the old plan of writing the date double (e.g., 1615/16), when the year instead of beginning with January, began in the spring, and that Mr. Roper spent much time in comparing the older records, and trying to assign the shocks to the proper year—so that his dates must not be lightly impugned.

The list is chronological, starting with the year 10 and coming

down to 1889, but a complete alphabetical index to localities is given at the end, and alongside of every statement is given the short title of the book, and the volume, and page whence it has been quoted.

ROYAL SOCIETY SOIRÉE.

Meteorology was not strongly represented this year, there being only two exhibits.

(1) *A Model illustrating the formation of Ocean Currents* by Mr. A. W. Clayden, M.A., F.G.S.

This consisted of a map of the Atlantic, on Mercator's projection, in which the seas were represented by the surface of some water over which Lycopodium powder had been scattered.

A foot blower was attached, and when it was worked a gentle blast of air was delivered from a number of tubes, in such a way as to set up a circulation of air resembling that of the atmosphere over the real ocean. These imitation prevalent winds acted upon the water, and created a system of currents resembling those of nature.

Special attention was directed to the Gulf Stream, issuing from the Gulf of Mexico, to the return current flowing eastwards between the two great equatorial currents, and to the Labrador current flowing from Baffin's Bay.

Portions of Central America were made removable, and when they were taken out it was noticed how the water of the Gulf Stream fails to reach our shores.

(2) *Air Meter for registering high velocities* exhibited by Mr. W. H. Dines, B.A.

ANCHOR ICE ON THE SEVERN.

This description of ice, locally called stock or frodge ice, is not uncommon on the Severn in frosty weather, between Stourport and Gloucester.

In severe frosts, the lampern wheels and putcheons (wicker-work constructions for catching lamperns and eels) are lifted from the bottom of the river, dragging their anchor stones, bricks, &c., with them, the wheels and putcheons being then double their ordinary size from the ice coated upon them.

Ice also at such times frequently rises from the bottom of the river, especially in the neighbourhood of fords or other shallow places.

It also sometimes accumulates on the weirs—as in January, 1881—to such an extent as, if not removed, to raise the water in the river several feet. It must be cleared away before the floating ice comes down or a block would ensue.

This anchor ice will sometimes freeze on the walling and stones of the weirs completely down to the bottom.

H. J. M.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCTOBER, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	68·8	27	28·2	8	55·4	38·9	41·1	84	99·8	21·3	1·28	7	5·5
Malta	88·8	5	52·0	23	74·5	62·4	58·6	74	135·8	47·4	4·06	7	3·7
<i>Cape of Good Hope</i> ...	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mauritius</i>	82·7	31	62·0	17	78·4	65·7	63·0	76	133·3	54·3	1·60	14	6·0
Calcutta.....	91·4	2	66·9	21	87·1	72·9	70·9	66	153·7	59·1	2·51	4	2·6
Bombay.....	94·5	19	74·4	4	90·1	77·3	74·0	73	144·4	62·8	·11	1	1·8
Ceylon, Colombo.....	88·7	10	72·0	20	86·4	74·6	71·8	78	145·5	69·3	15·77	23	7·3
Melbourne	86·0	13	35·1	9	65·1	46·7	43·8	64	145·0	27·7	1·35	8	5·0
Adelaide	91·9	23	41·5	8	73·8	51·7	44·0	50	146·9	30·7	·31	5	3·8
Wellington	67·0	28	39·5	3	60·3	47·3	45·3	73	135·0	34·0	3·37	13	3·6
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston.....	94·4	21	64·7	26	90·8	71·6	73·4	76	...	...	1·83	...	...
Barbados	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	62·2	31	28·3	21	50·0	36·4	37·5	78	...	19·0	2·65	20	7·3
New Brunswick, Fredericton	63·7	7	26·0	1	48·9	33·8	35·6	79	...	...	9·99	20	6·9
Manitoba, Winnipeg ...	71·2	6, 7	20·3	5	49·0	36·0	34·8	82	...	...	2·71	13	6·8
British Columbia, Victoria	69·0	4	31·0	30	57·6	44·7	...	...	...	...	3·35	14	...

REMARKS, OCTOBER, 1888.

MALTA.—Mean temp. 67°·5; mean hourly velocity of wind 10·7 miles. Sea temp fell from 77°·9 to 69°·0. TSS on 8th, 10th, and 12th. L on 17th. J. SCOLES.

Mauritius.—Mean temp. of air 0°·1 below, of dew point 1°·7 above, and E ·02 in. below average. Mean hourly velocity of wind 9·2 miles, or 2·5 below average; extremes 26·2 miles on 7th and 0·0 on 28th. Prevailing direction, E.S.E.

C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·7, of dew point 2°·5 humidity 6, mean amount of cloud 1·0, and E 1·50 in. below the average. Pressure 160 in. above the average. Prevailing wind S.W. and S.; strong on 11 days. Heavy dew on the 2nd. T and L on the 14th.

R. L. J. ELLERY, F.R.S.

Adelaide.—The driest October on record, the E being 1·5 in. below the average of 31 years. Mean temp. 1° above the average.

C. TODD.

Wellington.—Showery, with intervals of fine weather. Prevailing wind N.W., strong or stormy on 13 days. Distant T on 24th. Hail on night of 21st. Earthquakes on 23rd and 26th. Mean temp. average; E 1·46 in below average.

R. B. GORE.

FREDERICTON.—6·81 in. of E in the first 8 days; water in the river as high as an ordinary spring freshet.

VICTORIA.—Unusually dull and overcast.

SUPPLEMENTARY TABLE OF RAINFALL,
 APRIL, 1889.

 [For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	2.63	XI.	Castle Malgwyn	2.53
„	Margate, Birchington...	2.01	„	Rhayader, Nantgwillt..	6.36
„	Littlehampton	2.08	„	Carno, Tybrith	4.69
„	Hailsham	2.06	„	Corwen, Rhng	4.93
„	Ryde, Thornbrough	2.26	„	Port Madoc	4.35
„	Alton, Ashdell	2.54	„	I. of Man, Douglas	3.52
III.	Oxford, Magdalen Col..	2.51	XII.	Stoneykirk, Ardwell Ho.	2.14
„	Banbury, Bloxham	2.84	„	New Galloway, Glenlee	3.30
„	Northampton	1.69	„	Melrose, Abbey Gate...	3.32
„	Cambridge, Beech Ho..	2.10	XIII.	N. Esk Res. [Penicuik]	3.40
„	Wisbech, Bank House..	2.17	XIV.	Ballantrae, Glendrishaig	2.71
IV.	Southend	2.02	„	Glasgow, Queen's Park.	1.29
„	Harlow, Sheering	1.92	XV.	Islay, Gruinart School..	2.36
„	Rendlesham Hall	1.69	XVI.	Dollar	3.85
„	Diss	2.03	„	St. Andrews, Pilmour Cot	3.03
„	Swaffham	2.15	„	Balquhiddy, Stronvar..	4.90
V.	Salisbury, Alderbury...	2.16	„	Dunkeld, Inver Braan..	4.41
„	Warminster	3.09	„	Dalnaspidal H.R.S.	5.31
„	Bishop's Cannings	3.24	XVII.	Keith H.R.S.	4.07
„	Ashburton, Holne Vic. ...	2.61	„	Forres H.R.S.	2.13
„	Hatherleigh, Winsford.	1.41	XVIII.	Strome Ferry H.R.S.	2.21
„	Lynmouth, Glenthorne.	2.16	„	Fearn, Lower Pitkerrie.	1.72
„	Probus, Lamellyn	2.87	„	Loch Shiel, Glenaladale	4.13
„	Launceston, S. Petherwin	1.93	„	N. Uist, Loch Maddy ...	1.79
„	Wincanton, Stowell Rec.	3.92	„	Invergarry	3.73
„	Taunton, Lydeard Ho. ...	2.52	„	Loch Ness, Drumnadrochit	2.07
„	Wells, Westbury	3.54	XIX.	Lairg H.R.S.	2.71
VI.	Bristol, Clifton	4.77	„	Forsinard H.R.S.	...
„	Ross	5.64	„	Watten H.R.S.	2.69
„	Wem, Clive Vicarage ...	4.62	XX.	Dunmanway, Coolkelure	4.93
„	Cheadle, The Heath Ho.	2.69	„	Fermoy, Gas Works ...	3.00
„	Worcester, Diglis Lock	3.41	„	Tipperary, Henry Street	3.31
„	Coventry, Coundon	3.57	„	Limerick, Kilcornan ...	2.15
VII.	Ketton Hall [Stamford]	2.88	„	Miltown Malbay	2.73
„	Grantham, Stainby	3.32	XXI.	Gorey, Courtown House	1.93
„	Horncastle, Bucknall ...	2.05	„	Navan, Balrath	2.52
„	Mansfield, St. John's St.	3.55	„	Mullingar, Belvedere ...	2.56
VIII.	Neston, Hinderton	2.85	„	Athlone, Twyford	2.57
„	Knutsford, Heathside ...	2.57	„	Longford, Currygrane...	2.72
„	Lancaster, South Road.	2.31	XXII.	Galway, Queen's Coll...	2.03
„	Broughton-in-Furness ..	2.97	„	Clifden, Kylemore	3.24
IX.	Wakefield Prison	3.18	„	Crossmolina, Enniscoe..	3.03
„	Ripon, Mickley	3.12	„	Collooney, Markree Obs.	3.31
„	Scarborough, West Bank	3.41	„	Ballinamore, Lawderdale	...
„	East Layton [Darlington]	3.60	XXIII.	Warrenpoint	3.72
„	Middleton, Mickleton...	2.85	„	Seaforde	4.25
X.	Haltwhistle, Unthank..	2.88	„	Belfast, New Barnsley..	3.57
„	Shap, Copy Hill	3.17	„	Bushmills, Dundarave...	3.06
XI.	Llanfrehifa Grange	4.53	„	Stewartstown	3.32
„	Llandovery	3.68	„	Buncrana	3.14

APRIL, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				Mo. Night below 32°.
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Days on which 0.1 or more fell.	Max.		Min.			
				Dpth.	Date.		Deg.	Date	Deg.	Date		
inches.	inches.	in.										
I.	London (Camden Square) ...	2.06	+ .04	.35	23	20	63.9	19	32.4	16	0.2	
II.	Maidstone (Hunton Court)...	2.59	+ .74	.48	25	17	...	...	...	...	...	
III.	Strathfield Turgiss ...	2.30	+ .39	.46	6	21	62.8	18	31.8	1	1.1	
III.	Hitchin ...	2.30	+ .35	.35	10a	19	62.0	18	32.0	15	0.0	
IV.	Winslow (Addington) ...	2.61	+ .30	.37	23	22	65.0	18	30.0	16a	2.0	
IV.	Bury St. Edmunds (Culford)	...	...	...	...	...	...	...	...	...	...	
V.	Norwich (Cossey) ...	1.96	+ .10	.32	13	19	...	...	...	...	...	
V.	Weymouth (Langton Herring)	1.82	...	.66	7	14	60.0	18b	35.0	6, 16	0.0	
"	Barnstaple ...	1.09	- 1.29	.30	23	11	58.0	19	32.0	10	0.0	
"	Bodmin ...	1.74	- 1.59	.29	27	15	58.0	18	34.0	8	0.0	
VI.	Stroud (Upfield) ...	4.69	+ 2.24	1.00	8	22	65.0	18	34.0	15	0.0	
"	Churchstretton (Woolstaston)	5.75	+ 3.43	.67	8	24	63.0	18	30.0	15	3.11	
"	Tenbury (Orleton) ...	4.67	+ 2.50	.92	8	21	66.2	18	30.0	26	6.9	
VII.	Leicester (Barkby) ...	3.18	+ 1.30	.81	10	20	65.0	28	31.0	15	2.16	
"	Boston ...	2.34	+ .45	.44	28	22	68.0	19	30.0	3	3.0	
"	Hesley Hall [Tickhill] ...	2.43	...	.40	6	20	63.0	27	31.0	15	1.0	
VIII.	Manchester (Ardwick) ...	2.08	+ .05	.34	10	16	64.0	27	34.0	15	0.0	
IX.	Wetherby (Ribston Hall) ...	2.02	- .49	.42	7	13	...	...	...	...	...	
"	Skipton (Arnccliffe) ...	3.84	+ .78	.60	23	20	61.0	17	32.0	14	0.0	
"	Hull (People's Park) ...	2.35	+ .62	.45	28	21	...	...	...	...	...	
X.	North Shields ...	2.19	+ .19	.41	30	21	63.0	20	30.0	2	3.0	
"	Borrowdale (Seathwaite) ...	5.64	+ .70	.74	22	20	...	...	...	...	...	
XI.	Cardiff (Ely) ...	3.19	+ .35	.45	30	21	...	...	...	...	...	
"	Haverfordwest ...	2.67	- .15	.40	23	18	60.0	19	31.0	10	2.11	
"	Plinlimmon (Cwmsymlog) ...	5.16	...	.78	23	17	...	...	...	...	...	
"	Llandudno ...	4.72	+ 2.84	.80	8	20	55.8	28	33.0	15	2.0	
XII.	Cargen [Dumfries] ...	2.69	+ .40	.53	3	16	60.0	17	30.0	15	4.0	
"	Jedburgh (Sunnyside) ...	2.55	+ .35	.35	28	21	59.0	17c	30.0	3	2.0	
XIV.	Old Cumnock ...	1.84	+ .18	.28	3	18	60.0	28	27.0	14f	9.0	
XV.	Lochgilhead (Kilmory) ...	3.28	+ .65	.59	19	14	...	...	...	...	...	
"	Oban (Craigvarren) ...	2.54	...	.77	19	16	57.8	28	30.2	14	1.0	
"	Mull (Quinish) ...	2.52	...	.43	3	15	...	...	...	...	...	
XVI.	Loch Leven Sluices ...	3.80	+ 1.59	.80	14	9	...	...	...	...	...	
"	Dundee (Eastern Necropolis)	3.65	+ 1.53	.65	30	19	65.2	17	30.8	2, 3	2.0	
XVII.	Braemar ...	4.09	+ 2.01	.76	30	23	61.2	17	28.0	3, 26	7.22	
"	Aberdeen (Cranford) ...	3.49	...	.43	3	25	66.0	18	32.0	2	0.0	
XVIII.	Lochbroom ...	2.24	...	.44	23	20	...	...	...	...	...	
"	Culloden ...	1.22	- .13	...	...	...	59.0	17	32.0	3, 26	0.22	
XIX.	Dunrobin ...	3.11	...	.90	3	15	59.5	18	29.0	3	3.0	
"	S. Ronaldsay (Roeberry) ...	2.38	+ .53	.58	10	23	...	...	...	...	...	
XX.	Cork (Blackrock) ...	3.45	+ .35	1.06	27	18	60.0	17	30.0	12	4.0	
"	Dromore Castle ...	3.56	...	.80	29	18	61.0	26	32.0	8	0.0	
"	Waterford (Brook Lodge) ...	1.91	...	.23	21	19	63.0	17	27.0	15	2.0	
"	O'Briensbridge (Ross) ...	2.86	...	1.17	27	16	60.0	*	34.0	1	0.0	
XXI.	Carlow (Browne's Hill) ...	2.01	- .56	.30	3	20	...	...	...	...	...	
"	Dublin (Fitz William Square)	2.61	+ .50	.42	11	21	59.7	20	33.1	15	0.8	
XXII.	Ballinasloe ...	2.35	+ .09	.76	27	18	57.0	19	28.0	12	4.0	
XXIII.	Waringstown ...	4.11	+ 2.22	1.12	8	17	64.0	18	30.0	14	1.13	
"	Londonderry (Creggan Res.) ...	3.14	...	.91	3	19	...	...	...	...	...	
"	Omagh (Edenfel) ...	3.09	+ 1.09	.53	3	21	55.0	17d	34.0	3, 14	0.0	

b And 20, 21. c And 19. d And 18, 19, 20. e And 26. f And 25. * Several days.
 + Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON APRIL, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRAATHFIELD TURGISS.—The month commenced with rainy and unsettled weather, and with a low temp. Crops generally looking well at the close. T on 5th, 23rd and 30th; H on 5th and 23rd.

WINSLOW, ADDINGTON.—Greater amounts of R have been recorded in April, but never such a number of rainy days. The nights were cold throughout, but there was very little frost. Swallows arrived on 16th, and the cuckoo on 22nd, its time of arriving varies very little, no matter what the weather may be. T on 5th, 11, 12th, 23rd and 30th; H on 4th, 11th, 23rd and 28th. Some S on 3rd.

WYMOUTH, LANGTON HERRING.—A typical April. R '49 below the average. Mean temp. 0°·6 above the average of 17 years. Heavy TS on 12th, and a slight one on 24th. Well defined solar halo on 27th.

BODMIN.—A cold April, but the temp. very similar to that of the five previous Aprils. Mean temp. 45°·8.

WOOLSTASTON.—A cold, ungenial month, the first fortnight being specially inclement and very dark, with constant fog and R. S fell heavily on 6th, 7th and 10th, and again more lightly on 12th. T on 6th, 8th and 24th. Mean temp. 43°·2.

OBLETON.—The first 14 days were very cold, with R every day, and generally a cloudy sky. The remainder of the month was warmer and drier, but the mean temp. of the whole month was about 3° lower than the average of 28 years, although it was nearly 1° higher than that of April, 1888. The R was the largest in April for 58 years, except 1858. On the 8th R set in and continued more or less till the 11th, when about 2·25 in. had fallen, which produced great and long-continued floods in the rivers Teme and Severn. Distant T on 6th, 8th, 23rd, 24th and 30th, and on the 8th, 24th and 30th there were heavy storms within 20 miles. On the morning of the 11th, the hills were covered with S. Cuckoo heard on 21st; chiff-chaff seen about the 6th; and the small summer birds about the 25th, but the swallow has rarely been seen.

BARKBY.—The total R for the first four months this year is 10·57 in., as against 5·57 in. in 1888, or nearly double. First swallow seen on 6th; cuckoo heard on 11th. Mean temp. 45°·6. Vegetation some 10 days backward. T, with heavy H, on 4 days.

HULL.—The month was generally cold, wet, and overcast.

WALES.

HAVERFORDWEST.—The weather was most variable throughout the month, very showery, changeable, and at times very cold, especially from the 5th to the 16th, though there were very few frosts. Although the total R was small, the general character of the month was rainy throughout. Mean temp. rather above the average. Plenty of grass and crops looking well. Blackthorn in flower on 11th; horse chestnut in leaf on 25th. Cuckoo heard on 25th.

SCOTLAND.

CARGEN.—A cold, gloomy month, temp. 2°·6 below the average. Easterly winds prevailed for 17 days, and the duration of sunshine was 53 hours below the average. Vegetation backward.

JEDBURGH.—The weather was cold and ungenial, with much R; still, vegetation progressed fairly. Swallows not yet arrived.

CRAIGVARRAN, OBAN.—The month was decidedly warmer than usual, and the E moderate; growth was abundant, and early flowers made a good appearance.

QUINISH, MULL.—A showery, unsettled, and rather cold month, but on the whole very favourable to spring vegetation; hardly any frost at night.

LOCHBROOM.—Upon the whole a capital working month. Very little snow or storm, or anything to retard farming, while sunshine and showers were prevalent, causing green pastures.

CULLODEN, INVERNESS.—The weather generally was cold and the spring late. A fall of about 4 inches of S on the night of the 10th.

IRELAND.

CORK.—The month was mostly fine, but the winds were cold, and there were a few slight H showers. The spring is considered to be backward. Mean temp. 46°.

DROMORE.—Very little progress in vegetation until the last week of the month.

WATERFORD.—E 62 in. below the average. Mean temp. 45°·4.

ROSS, O'BRIENSBRIDGE.—Splendid weather until the 27th, but on the morning of the 28th the hills were white with S. Swallows late; cuckoo reported himself only on the 1st May.

DUBLIN.—The month was generally cold, cloudy, changeable and showery, with low pressure, and a preponderance of polar winds. Gale on 28th and 30th; S or sleet on 4th; H on 21st, 22nd, 23rd and 24th. Temp. below the average, having been lower in only three Aprils since the observations commenced in 1860. T on 30th.

OMAGH, EDENFEL.—With the exception of a short interval from 13th to 18th, the weather was cold, wet, and gloomy, and bore the character of October, rather than April. Sowing and farming operations generally were much retarded, but although there was no warmth, there was no frost, so that ordinary vegetation is not backward. The early summer migrants arrived about a week late.

TERRIBLE THUNDERSTORM AT BOULOGNE, MAY 6TH.

AN extraordinary thunderstorm visited Boulogne on Monday evening. It was not discovered until some time after the storm how disastrous had been its effects. The town presents an extraordinary appearance, the extent of the destruction being almost beyond description, fissures having been cut in the streets eight or ten feet deep, and so terrible was the force of the torrent that huge paving and curb stones, some of them weighing from two to four hundred-weight, were torn up and hurled along by it for great distances. Openings were made sufficiently large to engulf a horse and cart; trees were in many cases torn up, and gardens washed away; while the basements in the lower part of the town were under water. The whole of the inhabitants were in a great state of terror, and it will take some time to restore the damage which has been caused. Subscriptions have been opened for the sufferers. Several persons had narrow escapes. One man was carried a considerable distance by the torrent and was much bruised. Two horses were killed by the lightning, and a man and woman were also struck.—*Daily News*.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXI.]

JUNE, 1889.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE NEW ENGLAND METEOROLOGICAL SOCIETY.

[THE demands on our space are such that we are frequently obliged to omit notice of good work. Hence alone it has been that we have not oftener reported the proceedings of the above-named Society. But its First Annual Exhibition has been such a success, and so many instruments not previously described in these pages were shown, that we reprint, with slight alterations, the account as given in the *Meteorological Journal*, omitting such parts as refer to instruments, &c., well known in this country. We have been favoured by Mr. Lawrence Rotch with a photograph of the exhibition, which is at once very acceptable and very tantalizing. One regrets the impossibility of having been there.—ED.]

THE EXHIBITION OF THE NEW ENGLAND METEOROLOGICAL SOCIETY.

SEVERAL months since, the New England Meteorological Society, following the annual custom of the Royal Meteorological Society of London, decided to hold a loan exhibition in Boston in connection with its fourteenth regular meeting. Accordingly a circular was issued, which was printed in the November issue of this Journal, requesting contributions of meteorological apparatus, photographs, charts and specimens. The exhibition was opened in the Physical Laboratory of the Massachusetts Institute of Technology, January 15, and was continued seven days.

The Blue Hill Meteorological Observatory displayed instruments used in its regular and experimental work. In the latter class were the registering aneroid barometer, wind-vane and thermometers, used by Professor Upton and Mr. Rotch during the late total solar eclipse in California, besides the registering actinometer put in action probably for the first time during a total solar eclipse. This instrument, which was made by Richard Brothers of Paris, has a bright and a black globe, in each of which is a thermometer, whose indications are registered on a drum, an ingenious device correcting the influence of changes of temperature upon the transmitting medium of the solar thermometers.

There were the Watkin and Hottinger aneroid barometers, the first being intended for mountain use without thereby sacrificing an open scale. To accomplish this, the needle travels three times around the dial in its passage from 23 inches to 31 inches, and an index, actuated from the axis of the needle, shows which of the concentric circles should be read.

In the Hottinger instrument the expansion and contraction of the vacuum box is measured by a micrometer and vernier to the thousandth of an inch. This instrument is the property of the U.S. Signal office. There was also the *thermomètre à marteau* made by Baudin. This is an alcohol minimum, but can be placed vertical, unlike any other, and its index is not subject to displacement by wind. A spring attached to the index keeps it in a fixed position, but is not strong enough to prevent the film of alcohol from drawing the index downward when the temperature falls. The thermometer is set by turning its bulb upward when an enamel rod in the bulb descends the bore, and, acting as a hammer, forces the index to the end of the column.

A simple portable anemometer is the one made by Hicks for the London Meteorological Office. In it the Robinson cups are geared to a dial, but can be disconnected by inverting a sand-glass. To determine the velocity of the wind, the cups are allowed to acquire the normal velocity before the sand-glass is turned over and the registration commenced. At the expiration of two minutes, when the sand has ceased to flow, the glass is reversed and the wind's velocity, in miles per hour, read off at leisure from the dial. This instrument costs in London £5, and if it could be manufactured cheaply in this country it would be a valuable adjunct to the equipment of the stations of our State Weather Services.

Among the new apparatus was the recording rain and snow gauge devised by S. P. Fergusson, and described in the November Journal.

A seismograph made from designs of Professor Ewing, of Dundee, Scotland, was also shown, in which a heavy disk is suspended by three wires, and below it is a vertical weighted rod in unstable equilibrium. A rod fulcrumed above the disk carries a lever with a pen which inscribes upon a smoked glass plate the direction and intensity of the horizontal components of the earthquake shock. The English instrument cost £15, but it is manufactured in San Francisco for £3.

The Harvard College Observatory showed a seismoscope, in which the time of the earthquake is obtained by having a pendulum break an electric current and start or stop a clock. Some tracings obtained by a pendulum seismograph of Prof. Ewing in Tokio, Japan, were loaned by Prof. Rockwood.

A form of the Jordan sunshine-recorder, modified by Prof. Pickering, was shown by the Harvard College Observatory. It is often difficult to find a position with exposure to both morning and afternoon sun. Accordingly the apparatus is made in two parts—

each being the half of a cylinder with its axis parallel to the earth's axis. These half cylinders contain blue print paper, which is acted upon by the sun shining through holes in the flat sides of the cylinders. These holes are moved down a notch each day, so that one sheet of paper lasts a week. One of the cylinders gives a record of the morning sun, the other of the afternoon sun, and the cylinders may be placed on opposite sides of a house, if necessary.

Another ingenious instrument devised by Prof. Pickering is the pole-star recorder. In this, a telescope and camera are combined so that the trail of the pole-star, as it describes a circle in the heavens, is photographed on the sensitized plate, if the sky be clear. Passing clouds cause the trail to be broken. An alarm clock closes the shutter of the camera at dawn, and can be made also to open it after dark. From these records the amount of cloudiness is obtained at night as it is obtained in the daytime from the sunshine recorder.

The aspiration psychrometer, invented by Dr. Assmann, of Berlin, for obtaining the temperature and humidity of the air under all circumstances, was shown by Mr. Rotch. The wet and dry bulbs of the thermometer are surrounded by a polished metal casing through which air is drawn by bellows at a uniform rate. For use in rain there is a second case to enclose the first.

The Fineman nephoscope, or cloud mirror, was recommended by the International Meteorological Committee. It has a black reflecting surface with means for orienting it and sighting the cloud image by which the direction of motion, and the relative velocity, of clouds can be determined.

Prof. Marvin, of the Chief Signal Office, exhibited a very delicate anemometer with conical cups made of aluminium, used to determine the constants of the anemometers of the Service.

The Signal Service exhibited much new apparatus, including the triple self-register for wind direction and velocity and rainfall. For obtaining the latter the gauge invented by Prof. Marvin is employed. A float in a tube makes an electric contact by means similar to those in the anemometer, for each five-hundredths of an inch of rainfall.

One of the new thermometers for registering electrically at a distance, made by Richard Brothers, of Paris, and just imported by the Signal Service for use at certain of its stations, was shown.

The Signal Service also showed the apparatus used by Sergeant Park Morrill in his study of atmospheric electricity. This included the gas-flame and mechanical collectors invented by Sergeant Morrill, the Trowbridge, Mascart and Mendenhall quadrant electrometers, and the Mascart photographic register. The Physical Department of the Institute of Technology also added to this collection the Clifton and Thomson portable electrometers and the Thomson electrostatic voltmeter.

To the Physical Department of the Institute belonged the thermometer comparators shown. One of these was for making com-

parisons of a mercurial with an air thermometer, the other for comparing the thermometers used by the Society's observers with a standard instrument, all being immersed in water for the purpose.

The Draper Manufacturing Co. sent from New York a beautifully finished recording barometer and some thermometers, and the Standard Thermometer Co., of Peabody, Massachusetts, exhibited a tele-thermometer, metallic thermometers and thermostats.

Among the curiosities of the exhibition were a bottle and a saucer fused together by lightning, and a piece of window glass which had been ground translucent by the sand-bearing winds of Cape Cod.

Professor Abbe sent his printed weather bulletins, first issued in September, 1869, at the Cincinnati Observatory. Soon after commencing, telegraphic reports were received from fifteen stations, and on October 6, predictions for Cincinnati and vicinity were begun.

Owing to the generous response to the circular requesting the loan of articles, particularly by the U.S. Signal Service, the exhibition was a success, and was so well attended by visitors that it was continued three days longer than was originally intended. Now that the feasibility of such an exhibition has been demonstrated, it is to be hoped that others will follow, as there can be no doubt of their effect in stimulating the study of meteorology.

THE THUNDERSTORMS OF MAY AND JUNE.

THE Royal Meteorological Society will have its hands full. It has been inviting information respecting thunderstorms, and has come upon a year in which they seem to be exceptionally numerous and destructive. It would be waste of labour, of time, and of money, for us to deal fully with the mass of material with which we have been favoured; it is far better to give here only some brief notes, and to pass on the information *in extenso* to the Thunderstorm Committee of the Royal Meteorological Society, who are the proper persons to deal with it.

MAY 23RD.

Hampstead.—Sharp TS in afternoon, with H as large as marbles; 68 in. of R, and one or two accidents by L.—B. WOODD SMITH.

Hadham House, Upper Clapton.—Very large H; 12 weighed exactly 12 grammes (185 grains), but they were not dense, and therefore out of the hundreds of square feet of glass in my garden not one pane was broken. Between 3.22 and 4.2 p.m. excessive R, during which 40 minutes nearly 2 inches fell, as there was only moderate R from 4.2 to 5.30, at which time 2.07 inches was measured.—J. PARNELL.

Warwick Road, Upper Clapton.—R during TS quite phenomenal = 2.65 in.—W. HAYWARD.

Enfield.—Violent TS, 1.15 p.m. to 4 p.m.; H 1 inch long; R 2.10 in.; tree struck close to house.—T. PAULIN.

Tottenham.—TS 3.15 to 5.15 p.m., with large H, and 1.45 in. of R in the 2 hours.—J. E. WORTH.

TSS and damage by L and by local floods in *Northampton, Rutland, and Lincoln.* *Barrowden* Church spire seriously damaged.

Walton, Wakefield.—TS between 1 and 2 p.m., yielding 1.15 in., the most in so short a time that I have registered during 14 years.—E. SIMPSON.

Doncaster.—TS in afternoon; house struck by L.

Normanton.—TS in afternoon; offices of the Local Board struck by L, also a house in *Altofts*.

N. Riding of Yorkshire.—Severe TSS, and much damage both by L and by H.

MAY 24TH.

Worcestershire.—Severe H storm. At *Martley* some H stones were 4 in. long; poultry and even one sheep killed. More than 24 hours afterwards H was measured $\frac{3}{4}$ in. in diameter. One farmer alone had 20 ducks and nearly as many chickens killed by the H. Cattle also killed by L and trees struck. As regards the H, it is said not to have been equalled since 1852, prior to which there were great H storms in 1830 and 1811.

Uppingham.—Sharp TS with H. Between 5.0 and 5.23 p.m., .51 in. fell, and of that probably .34 in. fell in the first nine minutes.—G. H. MULLINS.

Derbyshire.—TS and much damage done; one man killed.

Queensbury, Bradford.—Woman killed by L.

MAY 29TH.

Buildings struck at *Liverpool, Preston*, and other places in *Lancashire*. Hail up to $1\frac{1}{2}$ in. in diameter; local floods, and a whirlwind near *Frodsham, Cheshire*.

JUNE 2ND.

Meltham, Yorks.—Three TSS, one 7 to $7\frac{1}{2}$ a.m., another 8.50 to 9.20 a.m., and the third 2.35 to 5 p.m. During the last some exceptionally large H fell. One stone was measured $1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{2}$; 29 stones, when melted, gave 0.30 in. in an 8 in. rain gauge glass, so that each stone must have contained nearly half a cubic inch of water. Most of them had opaque centres and a coating of clear ice, but one was, and probably more were, composed of four layers, the kernel being opaque, then a layer of clear ice, then more opaque ice, and finally a clear ice coating. There was only one fall of these large ones, it lasted less than a minute, and they fell at an average distance of about three yards one from another.—C. L. BROOK.

Allendale, Northumberland.—Two houses struck by L.

Pawston, Cornhill-on-Tweed.—Very severe TS about noon; H $1\frac{1}{2}$ in. in diameter, and .62 in. of R in 20 minutes (time carefully noted).—B. P. SELBY.

Berwick-on-Tweed.—11 a.m. to 1 p.m. heavy TS with much H in many towns and villages. Much conservatory glass broken; at *Allanbank, Allanton*, over 1,000 panes were broken. The H was

frequently more than one inch long, perhaps $1\frac{1}{2} \times 1 \times \frac{1}{2}$, but it is often reported as 5 inches in circumference, which would give $1\frac{1}{2}$ in. in diameter.

JUNE 6TH.

Langton Herring, Dorset.—The most terrific TS for 28 years, began in evening of 6th and lasted till 6.30 a.m. of 7th. $R = 1.89$ in. A house damaged and a cow killed.—C. H. GOSSET.

Bishop's Cannings, Devizes.—Heavy TS, and six cottages burnt down.—C. W. HONY.

Camden Square.—Grand TS between 9 and 11 p.m.; L finer than I have seen since 1858. There were several separate centres of storm, mostly working from S. to N. No H of importance fell here, and the R was not exceptional, total 0.52 in.—G. J. SYMONS.

Northwood Road, Highgate.—The most glorious TS I ever saw. Heavy R, total 1.03 in., but the special feature was the beauty and frequency of the L. About 9.20 p.m. I began to count the displays, and, from a rough calculation, made the number up to that time 100; from then to 11.10 p.m. I counted 1,144 distinct displays, giving a total of 1,244 in two hours. Some of the flashes lasted perceptibly longer than others—in fact, one lasted while I counted up to ten.—H. SOWERBY WALLIS.

JUNE 7TH.

Rusper, Horsham.—Sharp TS between 1 and 2.30 p.m. In $1\frac{1}{4}$ hours 2.20 in. of R fell at Rusper Rectory, and in 30 minutes at Rusper House 0.86 in. was measured.—A. F. PARBURY.

Tunbridge Wells.—Sharp TS at 4 p.m., with H, which varied much in size in different parts of the town, but in Garden-road was as large as pigeon's eggs, and one stone was measured in Pembury-road the next day $1\frac{1}{2}$ inches in diameter.—T. COBB, JUN.

Ipswich.—Violent TS about 3 a.m., with much H. Many thousand squares of glass broken; indeed, the loss is put at 100,000 panes. No very large sizes are mentioned, but as the H broke 21 oz., and even 26 oz. glass, it must have been large and hard. At the Corn Exchange two lights, made with glass $\frac{1}{4}$ inch thick, were smashed. The storm continued in parts of Essex and Suffolk until after noon.

EARTHQUAKE SHOCK, MAY 30TH, 1889.

A RATHER sharp shock of earthquake was felt on both sides of the English Channel about 8.20 p.m. on May 30th.

STRUCTURAL DAMAGE.

This is, as far as we have heard, confined to the following:—

Cherbourg.—The windows of several houses broken, a bell turret on the Cathedral thrown down, and the cornice of the doorway of the Church of the Holy Trinity thrown to the ground.

Portsmouth.—Part of the plaster of the ceiling of St. Michael's Church fell among the congregation, and one young woman had her arm injured.

LIMITS WITHIN WHICH IT WAS FELT.

From France we have no reports south of latitude 48° , and it was felt most in Normandy and in Brittany. Paris seems to have been near the south-eastern limit. It was sharp in the Channel Isles, and caused suspended objects, lamps, lustres, cranes, &c., to oscillate along the English coast from the Land's End to Eastbourne, but it did not extend far inland. But for an isolated record from Henwick, near Worcester, we should have fixed the northern limit at which it was perceived as being slightly to the north of a line drawn through Bristol and London. We have eight or nine reports from London, but the letters with which we close this article sufficiently indicate its character towards its N.E. limits.

The reported times are not so discordant as usual, though they range from 8.14 to 8.30. The Channel Islands returns are mostly 8.14 or 8.15, and this is vexatious, because they are nearly equally wrong, whether this is supposed to be local or Greenwich time. If local time, then the shock is reported from there at about 8.24, which is probably four minutes later than the real time, and 8.15 is probably five minutes too early.*

Our impression is that the centre of the shock was nearly under Cherbourg, and at 8.20 p.m., and that the vibration travelled outwards at about 90 miles a minute, reaching the watering places on the south coast about 8.21, London 8.21½, and Worcester between 8.22 and 8.23.

This satisfies most of the coast reports, agrees precisely with Mr. Sowerby Wallis's time for Highgate, and agrees within a fraction of a minute with the most distant observation, viz., that at Worcester.

SIR,—I think it may interest you to know that two slight lateral shocks of earthquake were distinctly felt here last evening at about half-past eight. They were observed by two members of my family, one upstairs and one down. They were also observed next door. We read in the newspapers to-day that there were shocks of earthquake at Guernsey last evening at about 8.15.—Yours truly,
LEWIS HILL.

22, Parliament Hill Road, Hampstead, May 31st, 1889.

SIR,—On the evening of Thursday last (May 30th), sitting reading in a room here, facing S.E., I felt a movement which I at first attributed to a distant train, but as it had more of an undulatory character and was not followed by the passage of a train, it occurred to me that it might be an earthquake and I carefully noted the time, 8 hours 21 min. 30 sec. p.m.

* We are sorry to discredit these Channel Islands reports, but when we state that the records for Jersey and for Sark, which are within a few miles, differ by *eleven minutes* (= 1,000 miles travel of shock), it will be apparent why we have had to leave them out. When will people learn to keep their clocks right, and to be precise in noting the time of phenomena?

I intended to check my watch by a standard clock the next day, but, under the pressure of other matters, overlooked it. I have, however, fairly good evidence that the above is within a minute of true Greenwich time.

During the rest of the evening I remained in the same chair, and amused myself by noticing the very different character of the shaking caused by passing trains.

The sensation appeared to be that of an undulation travelling from S.E. to N.W.—Yours obediently,

H. SOWERBY WALLIS.

25, Northwood Road, Highgate, June 4th, 1889.

SIR,—You may be expecting information about the earthquake shock on the South Coast, perceived on the evening of May 30th. The following is the mem. I have made :—

May 30th.—About 8.15 to 8.20 p.m., a distinct earth-tremor from west to east was felt here, lasting for a few seconds. Not perceived by anyone in my own house, but distinctly opposite ; also by invalids in bed and by children, who woke up frightened and startled, saying their bed was being lifted up off the ground beneath them ; by others that the walls seemed to sway to and fro, west to east, and that crockery jingled. I have not been able to find that any clocks stopped. The weather was fine ; sky quite clear ; wind S.E. ; barometer 29.92, had been falling *very slightly* from 1 p.m. to 8 p.m., rising a fraction from 8 p.m. to 8.30 p.m., then steady till midnight ; the max. temp. in the shade for the day was 58° 6.—Yours very truly,

W. J. HARRIS.

Church House, Heene, Worthing, June 1st, 1889.

A COLD PERIOD.

M. LANCASTER has a paper on this subject in the last number (No. 6, 1889) of *Ciel et Terre*, entitled “The Temperature in Europe, 1885 to 1888,” to which we desire to call attention.

It may be remembered that in our March number we gave a table in which we compared the values for Greenwich, Paris, Brussels, and Toronto in each month of the last four years, with averages extending over long periods, and finally summed up by showing that the greatest deficiency of temperature was at Toronto in 1885, viz., —2° 6, followed by Paris in 1887, —2° 1, and Paris, 1888, —1° 9, and that, on the mean of the four years for the four stations, the deficiency was about 0° 8 per annum, and we therefore said :—

“We do not think that it is necessary to pursue the subject further, as all these values are within the limits of variation of mean annual temperature.”

M. Lancaster evidently does not think so, as he has devoted seven more pages of *Ciel et Terre* to it. We do not say that he was unwise in so doing, but we should like to show on what we relied in writing

the previous three lines. We found that at Greenwich the difference from the mean was, for the respective years :—

1886.	1886.	1887.	1888.	Mean for the four years.
0°·0	+0°·1	-0°·8	-1°·0	-0°·4

Then we turned to the useful and interesting diagram in Drew's *Practical Meteorology*, on which is plotted the mean temperature of every year from 1771 to 1853 at Greenwich, and we found such cases as the following* :—

* We have taken the Greenwich mean temp. at 49°·0; this is probably rather too low, but we prefer to take a value which cannot be impugned.—See *Quar. Jour., Roy. Met. Soc.*, vol. xiv., p. 34.

1784.	1785.	1786.	1787.	Mean.
-4°·0	-2°·6	-3°·2	-0°·9	-2°·7
1796.	1797.	1798.	1799.	
-1°·2	-1°·8	-0°·4	-3°·3	-1°·7
1813.	1814.	1815.	1816.	
-1°·8	-3°·2	-0°·1	-2°·6	-1°·9
1837.	1838.	1839.	1840.	
-1°·7	-2°·6	-1°·3	-1°·2	-1°·7

Every one of these groups is more than four times as remarkable as the 1885—88 period, and that is why we thought that we had devoted sufficient time and attention to the matter.

On the other hand, meteorology is in many branches so much of a puzzle that no one can presume to dictate the path which will lead to the discovery of the key to the whole, and therefore we welcome the efforts which M. Lancaster has made, and we hope will continue, to track the conditions which have produced this recent cold period.

We can, of course, reproduce here only fragments from M. Lancaster's article, but we will endeavour to select such as will bring out the salient points :—

Nearest Similar Periods at Brussels.

Nov. 1841 to Oct. 1845, 48 months,	30 months below the mean;	aver. defect	1°·3
Nov. 1846 to Oct. 1850, 48	28	„	0°·7
Feb. 1853 to Jan. 1857, 48	27	„	1°·1
Nov. 1884 to Oct. 1888, 48	32	„	1°·4

Defects in 1885—88 in various parts of Europe.

	Lat.	Lon.	Months below mean.	Average defect. deg.
St. Martin de Hinx, Bayonne, France	43° 45' ...	1° 16' W.	37	2·2
Perpignan, France	42 43 ...	2 53 E.	36	1·8
Tarm, West Denmark	55 53 ...	8 31 E.	38	1·8
Löningen, Oldenbourg	52 44 ...	7 44 E.	33	1·6
Göttingen	51 32 ...	9 56 E.	33	1·4
Madrid, Spain	40 25 ...	3 43 W.	34	1·4
Brussels, Belgium	50 52 ...	4 21 E.	32	1·4
Utrecht, Holland	52 5 ...	5 7 E.	32	1·4
Shields, Northumberland, England	55 0 ...	1 27 W.	33	1·3
Paris, France	48 50 ...	2 20 E.	29	1·0
Stornoway, Lewis, Scotland	58 11 ...	6 22 W.	34	0·9
Lisbon, Portugal	38 41 ...	9 10 W.	33	0·7
Greenwich, England	51 28 ...	0 0	28	0·4

Relative Intensity in Eastern and in Western Europe.

M. Lancaster proceeds to divide 22 records into two groups,

11 easterly and 11 westerly stations, and he finds that, at the westerly stations, the deficit was $1^{\circ}3$, and at the easterly only half as much, or $0^{\circ}7$; he states further that, at Genoa and Milan, there has been an excess, but he does not state the amount.

It seems to us that the above table shows such irregularities as prove that M. Lancaster has a heavy task before him, and this is corroborated by the consideration that, besides the most fruitful source of error—changed instruments, changed positions, and in many cases changed modes of computing the mean temperature—there is the fact of no two observatories quoting averages extending over precisely the same group of years. Probably the best plan would be to collect a very large number of reports, so that errors may be diminished by neutralization. Certainly cases of excess should be reported as carefully as those of defect, because it is quite likely that in them may be found the explanation of the persistent cold.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday, May 15th, at the Institution of Civil Engineers, 25, Great George-street, Westminster. Dr. W. Marcet, F.R.S., President, in the chair.

Mr. T. H. Hall was elected a Fellow of the Society.

The following papers were read:—

1. "Account of some experiments made to investigate the connection between the Pressure and Velocity of the Wind," by Mr. W. H. Dines, B.A., F.R.Met.Soc. These experiments were made for the purpose of determining the relation between the velocity of the wind and the pressure it exerts upon obstacles of various kinds exposed to it. The pressure plates were placed at the end of the long arm of a whirling machine, which was rotated by steam power. The author gives the results of experiments with about 25 pressure plates, all differing in shape or size. The pressure upon a plane area of fairly compact form is about $1\frac{1}{2}$ lbs. per square foot for a velocity of 21 miles per hour; or, in other words, a pressure of 1 lb. per square foot is caused by a wind of a little more than 17 miles per hour.* The pressure upon the same area is increased by increasing the perimeter. The pressure upon a $\frac{1}{4}$ ft. plate is proportionally less than that upon a plate either half or double its size. The pressure upon any surface is but slightly altered by a cone or rim, projecting at the back, a cone seeming to cause a slight increase, but a rim having apparently no effect.

2. "On an improved method of preparing Ozone papers, and other

* This is the most satisfactory statement that we have seen respecting anemometry for a long time. As far back as 1860 Col. Sir H. James, R.E., F.R.S., gave 14.1 miles as the equivalent of 1 lb., and in 1861 Mr. Harvey Simmonds gave it as 14.8 miles. Hence all authorities seem to agree that when the wind exerts a pressure of 1 lb. on a square foot it is moving with a velocity of between 14 and 17 miles an hour.—ED.

forms of the test, with starch and potassium iodide," by Dr. C. H. Blackley, F.R.Met.Soc. Some years ago the author made some experiments with the ordinary ozone test papers, but found that the papers did not always give the same result when two or more were exposed under precisely the same conditions. He subsequently tried what re-action would take place between unboiled starch and potassium iodide when exposed to the influence of ozone; but the difficulty of getting this spread evenly upon paper by hand, so as to ensure a perfectly even tint after being acted upon by ozone, led him to devise a new method of accomplishing this. Briefly described, it may be said to be a method by which the starch is deposited upon the surface of the paper by precipitation, and for delicacy, and precision in regulating the quantity on any given surface, it leaves very little to be desired.

3. "Notes on the Climate of Akassa, Niger Territory," by Mr. F. Russell, F.R.G.S. This paper gives the results of observations made from February, 1887, to October, 1888, at Akassa, which is the seaport and principal dépôt of the Royal Niger Company, and is situated at the mouth of the River Nun in the Niger Delta.

4. "Wind Storm at Sydney, New South Wales, on January 29th, 1889," by Mr. H. C. Russell, F.R.S.

WATERSPOUT IN DORSET, JUNE 7TH.

A correspondent of *The Times* at Yeovil, telegraphing on the 9th inst., says:—

"A great disaster befell a rural district of Dorsetshire on Friday evening last. During the afternoon thunder and lightning had been incessant, but very little rain had fallen. About six o'clock in the evening great waves of water from eight to ten feet high rolled down the Batcombe hills upon the little village of Chetnole. What is ordinarily a small brook supplying a millstream became a powerful torrent, and spread alarm among the inhabitants. At Hannaford Mill great damage was done, and stock of all kinds were drowned. At Chetnole Mills the devastation was very great. The torrent brought with it large trees which it had uprooted. Everything that stood in its path was swept away. Men who were working at the mill engines had only just time to rush out of the building before the water reached the top of the first floor. Several school children were rescued by Major Digby. The damage to property is estimated at several thousand pounds. The villages of Cerne and Mintern also suffered greatly, and miles of road were washed away. Several cottagers had all their furniture carried away. The cause of the remarkable occurrence was for some time unknown. It has now been ascertained that a waterspout burst on Batcombe-hill. An eye-witness described it as a solid stream of water of about the thickness of a man's body. It tore up the ground to a considerable depth, and forced a channel for its escape down the hillside."

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, NOVEMBER, 1888.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth. inches.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	59·9	16	34·6	28	51·0	43·3	43·3	87	78·9	28·2	4·38	20	7·9
Malta	77·6	2	49·1	23	69·0	57·2	53·0	75	126·3	43·6	·74	7	4·4
Cape of Good Hope. ...	81·8	13	48 0	4	67 8	53·5	...	...	...	...	1·42	8	...
Mauritius	84·6	23	67·0	16	82·1	70·1	65·1	71	138·1	59·1	1·25	15	6·1
Calcutta.....	86·7	1	58·3	19	80·9	65·5	64·4	68	148·5	49·4	3·13	2	4·2
Bombay.....	95·6	2	70·0	21	88·2	75·4	70·9	70	144·6	58·1	1·16	7	3·3
Ceylon, Colombo.....	88·7	...	71·8	...	86·8	73·8	72·5	81	154·0	68·2	14·19	21	6·2
Melbourne	102·0	23	38·1	1	74·1	51·8	49·4	64	145·9	28·4	·62	6	4·8
Adelaide	105·8	23	46·4	11	83·4	59·4	49·3	45	156·8	39·4	·66	8	3·5
Wellington	66·5	19	39·0	2, 25	60·8	46·4	44·9	72	138·0	33·0	7·10	20	4·4
Auckland	71·0	17a	45 0	10, 25	63·3	50·3	47·4	70	135·0	36·0	3 63	22	6·0
Jamaica, Kingston.....	94·3	13	63·7	27	91·3	70·2	70·7	74	...	...	·07	...	...
Barbados	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	62·0	1	14·1	23	43·9	31·3	33·6	80	...	9·0	3·10	19	7·6
New Brunswick, Fredericton	60·7	2	—0·5	23	39·7	23·6	30·7	80	...	...	6·47	15	6·0
Manitoba, Winnipeg ...	46·7	12	—4·0	19	32·5	16·6	21·2	85	...	...	·50	11	6·1
British Columbia, Victoria	55·0	1	25·0	16	47·5	37·9	...	...	...	...	2·69	16	...

a And 18.

REMARKS, NOVEMBER, 1888.

MALTA.—Mean temp. 61°·8; mean hourly velocity of wind 10·7 miles. Sea temp. fell from 69°·0 to 64°·8. TS on 19th; L on 22nd and 23rd; H on 23rd. R 3·39 in. below average. J. SCOLES.

Mauritius.—Mean temp. of air 1°·6 above, of dew point 1°·5 above, and R ·56 in. below their respective averages. Mean hourly velocity of wind 10·5 miles, or 0·8 below average; extremes 28·2 on 11th and 2·2 on 1st and 8th. Prevailing direction, E. by N. T on 7th, L on 18th, and T and L on 19th. Fine solar halos on 10th and 16th. Floods in the southern part of the island on 19th. C. MELDRUM, F.R.S.

COLOMBO.—TSS on 17 days and L on one other day. J. C. H. CLARK.

Melbourne.—Mean temp. of air 2°·5 and of dew point 0°·9 above the average; humidity 3, mean amount of cloud 1, and R 1·92 in. below the average. Prevailing winds S. and S.W.; stormy on 13 days. Distant T on 2nd and 27th; T and L on the 9th; L on the 2nd and 3rd. R. L. J. ELLERY, F.R.S.

Adelaide.—The hottest November on record. Mean temp. nearly 5° above the average of 32 years. R two-thirds of the average. Drought general over the whole colony. C. TODD, F.R.S.

Wellington.—Unpleasant and showery weather almost throughout. Strong S.E. wind on the 9th, 10th, and 11th; cold and stormy from 13th to 16th. Prevailing wind N.W. T on 20th; H on 1st and 23rd. Mean temp. 2°·9 below and R 2·93 in. above average. R. B. GORE.

Auckland.—Unusually cold, stormy, and showery. Mean temp. 4° below the average, and the lowest recorded for November. R ·75 in. above the average; pressure considerably below it. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
MAY, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	4·03	XI.	Castle Malgwyn	2·60
"	Margate, Birchington...	2·02	"	Rhayader, Nantgwillt..	4·10
"	Littlehampton	2·28	"	Carno, Tybrith	3·91
"	Hailsham	1·43	"	Corwen, Rhug	3·89
"	Ryde, Thornbrough	2·03	"	Port Madoc	2·27
"	Alton, Ashdell	3·51	"	I. of Man, Douglas	2·67
III.	Oxford, Magdalen Col...	2·91	XII.	Stoneykirk, Ardwell Ho.	3·37
"	Banbury, Bloxham	3·81	"	New Galloway, Glenlee	4·37
"	Northampton	3·34	"	Melrose, Abbey Gate...	2·08
"	Cambridge, Beech Ho...	3·92	XIII.	N. Esk Res. [Penicuik]	2·45
"	Wisbech, Bank House..	3·65	XIV.	Ballantrae, Glendrisaig	3·42
IV.	Southend	2·40	"	Glasgow, Queen's Park.	3·19
"	Harlow, Sheering	3·89	XV.	Islay, Gruinart School..	2·12
"	Rendlesham Hall	2·47	XVI.	Dollar	2·60
"	Diss	2·87	"	St. Andrews, Pilmour Cot	1·59
"	Swaffham	2·72	"	Balquhiddie, Stronvar..	5·02
V.	Salisbury, Alderbury ...	2·03	"	Dunkeld, Inver Braan...	3·20
"	Warminster	...	"	Dalnaspidal H.R.S. ...	3·49
"	Bishop's Cannings	1·98	XVII.	Keith H.R.S.	·32
"	Ashburton, Holne Vic...	3·10	"	Forres H.R.S.	·45
"	Hatherleigh, Winsford.	3·07	XVIII.	Strome Ferry H.R.S....	2·19
"	Lynmouth, Glenthorne.	3·53	"	Fearn, Lower Pitkerrie.	·66
"	Probus, Lamellyn	3·88	"	Loch Shiel, Glenaladale	3·74
"	Launceston, S. Petherwin	3·31	"	N. Uist, Loch Maddy ...	2·40
"	Wincanton, Stowell Rec.	2·32	"	Invergarry	1·39
"	Taunton, Lydeard Ho...	...	"	Loch Ness, Drumnadrochit	1·20
"	Wells, Westbury	4·07	XIX.	Lairg H.R.S.	·40
VI.	Bristol, Clifton	2·69	"	Forsinard H.R.S.	...
"	Ross	3·81	"	Watten H.R.S.	·47
"	Wem, Clive Vicarage ...	3·15	XX.	Dunmanway, Coolkelure	4·79
"	Cheadle, The Heath Ho.	3·64	"	Fermoy, Gas Works ...	3·42
"	Worcester, Diglis Lock	2·93	"	Tipperary, Henry Street	3·75
"	Coventry, Coundon	3·42	"	Limerick, Kilcornan ...	1·63
VII.	Ketton Hall [Stamford]	6·14	"	Miltown Malbay	4·80
"	Grantham, Stainby	4·71	XXI.	Gorey, Courtown House	3·07
"	Horncastle, Bucknall ...	3·77	"	Navan, Balrath	2·07
"	Mansfield, St. John's St.	3·77	"	Mullingar, Belvedere ...	2·69
VIII.	Neston, Hinderton	2·31	"	Athlone, Twyford	3·43
"	Knutsford, Heathside ...	2·66	"	Longford, Currygrane...	3·84
"	Lancaster, South Road.	4·10	XXII.	Galway, Queen's Coll...	4·41
"	Broughton-in-Furness ..	4·34	"	Clifden, Kylemore	7·91
IX.	Wakefield Prison	3·98	"	Crossmolina, Enniscoe..	4·97
"	Ripon, Mickley	2·62	"	Collooney, Markree Obs.	4·76
"	Scarborough, West Bank	2·41	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	2·05	XXIII.	Warrenpoint	3·90
"	Middleton, Mickleton ..	1·48	"	Seaforde	3·33
X.	Haltwhistle, Unthank..	1·38	"	Belfast, New Barnsley..	1·89
"	Shap, Copy Hill	2·85	"	Bushmills, Dundarave...	2·48
XI.	Llanfrehfa Grange	3·76	"	Stewartstown	3·50
"	Llandovery	3·91	"	Buncrana	4·13

MAY, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Nights below 32°	In shade.	On grass.
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Days on which -01 or more fell.	Max.		Min.					
				Dpth.	Date.		Deg	Date	Deg	Date.				
I.	London (Camden Square) ...	inches 3·22	inches. + 1·30	in. 1·08	26	14	81·2	24	42·7	2	0	0		
II.	Maidstone (Hunton Court)...	1·32	— ·70	·37	9	11	...	...	...	...	...	...		
III.	Strathfield Turgiss	3·36	+ 1·68	1·70	26	20	79·2	23	40·3	2	0	0		
	Hitchin	4·33	+ 2·34	1·37	11	19	77·0	24	40·0	2	0	...		
IV.	Winslow (Addington)	3·84	+ 1·11	1·12	26	15	80·0	23a	39·0	2	0	0		
	Bury St. Edmunds (Culford) ..	...	...	...	...	...	...	...	...	...	...	...		
V.	Norwich (Cossey)	3·15	+ 1·34	·90	10	9	79·0	24	...	...	...	...		
	Weymouth (Langton Herring) ..	1·24	— ·39	·8	11	11	73·0	24	43·0	1, 11	0	...		
	Barnstaple	3·43	+ 1·33	·70	16	17	70·0	23	35·0	11	0	...		
	Bodmin	4·35	+ 1·51	·85	8	19	68·0	22	40·0	2	0	0		
VI.	Stroud (Upfield)	3·11	+ ·81	·74	24	14	79·0	22	40·0	11	0	...		
	Church Stretton (Woolstaston) ..	3·24	+ ·85	·54	11	16	75·0	22	36·5	2	0	1		
	Tenbury (Orleton)	3·19	+ ·76	·74	24	17	78·2	22	35·0	2	0	0		
VII.	Leicester (Barkby)	3·69	+ 1·81	·90	26	18	84·0	24	35·0	1	0	0		
	Boston	3·16	+ 1·39	·82	10	14	85·0	22	37·0	3	0	...		
	Hesley Hall [Tickhill]	3·71	— ·76	·10	16	16	80·0	22	38·0	3	0	...		
VIII.	Manchester (Ardwick)	2·31	+ ·08	·65	11	13	75·0	22	42·0	1	0	...		
IX.	Wetherby (Ribston Hall) ...	2·95	+ 1·13	1·14	11	10	...	...	...	...	...	...		
	Skipton (Arncliffe)	2·95	— ·17	·72	10	13	81·0	22	45·0	10	0	...		
	Hull (People's Park)	2·95	+ 1·07	·64	10	13	...	...	...	...	...	...		
X.	North Shields	1·48	— ·37	·40	27	16	75·0	22	39·2	15	0	0		
	Borrowdale (Seathwaite)	5·79	+ 1·19	1·32	30	18	...	...	...	...	...	...		
XI.	Cardiff (Ely)	2·86	+ ·26	·70	31	17	...	...	...	...	...	...		
	Haverfordwest	3·39	+ ·70	·83	17	15	70·1	21	36·0	14	0	2		
	Plinlimmon (Cwmsymlog) ...	3·48	— ·65	·29	12	...	...	...	...	...	...	...		
	Llandudno	2·53	+ ·91	·47	16	15	68·2	21	40·5	2	0	...		
XII.	Cargen [Dumfries]	3·33	+ ·80	·68	10	15	76·4	21	39·0	27	0	...		
	Jedburgh (Sunnyside)	1·55	— ·24	·34	27	10	77·0	21	39·0	30	0	...		
XIV.	Old Cumnock	2·56	+ ·16	·45	10	15	81·5	21	34·0	26	0	...		
XV.	Lochgilthead (Kilmory)	3·04	+ ·28	·65	29	18	...	...	...	...	...	...		
	Oban (Craigvarren)	2·81	— ·75	·7	18	18	71·5	6	41·9	25	0	...		
	Mull (Quinish)	2·52	— ·40	·7	18	...	...	...	...	...	...	...		
XVI.	Loch Leven Sluices	3·10	+ ·81	·80	15	11	...	...	...	...	...	...		
	Dundee (Eastern Necropolis) ..	1·45	— ·49	·40	28	12	75·3	22	40·6	3	0	...		
XVII.	Braemar	1·30	— 1·12	·48	14	9	71·0	22	36·4	13	0	7		
	Aberdeen (Cranford) ...	1·18	— ·26	·31	10	10	71·0	22c	39·0	26	0	...		
XVIII.	Lochbroom	1·10	— ·24	·7	10	...	...	...	...	...	...	...		
	Culloden	·72	— 1·06	...	...	...	73·0	7d	41·0	26	0	0		
XIX.	Dunrobin	·83	— ·32	·29	6	...	68·8	21	40·0	1	0	...		
	S. Ronaldsay (Roeberry)	·66	— ·84	·22	1	7	69·0	22	41·0	18	0	...		
XX.	Cork (Blackrock)	4·72	+ 2·56	·80	2	16	70·0	27	40·0	12f	0	...		
	Dromore Castle	4·80	— ·62	·2	21	...	69·0	27	34·0	6	0	...		
	Waterford (Brook Lodge) ...	3·32	— ·62	·5	16	...	68·0	27	38·0	25g	0	...		
	O'Briensbridge (Ross)	2·32	— ·29	·29	18	...	72·0	22e	42·0	1	0	...		
XXI.	Carlow (Browne's Hill)	2·58	+ ·46	·64	5	16	...	...	...	...	...	...		
	Dublin (Fitz William Square) ..	2·13	+ ·41	·51	5	17	72·5	21	40·8	11	0	1		
XXII.	Ballinasloe	3·59	+ 1·18	·41	29	22	68·0	20	32·0	7	1	...		
XXIII.	Waringstown	2·35	+ ·24	·39	12	15	79·0	20	39·0	1h	0	0		
	Londonderry (Creggan Res.) ..	...	...	...	...	...	...	...	...	...	...	...		
	Omagh (Edenfel)	3·62	+ 1·27	·94	5	18	70·0	21	35·0	24	0	...		

α And 24. β And 21. γ And 23. δ And 21, 22. ε And 23. f And 14. g And 27. h And 26, 30.
+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON MAY, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The weather was very unsettled at the beginning of the month, but was relieved by a few spring-like days of sunshine. E storms were frequent, and the temp. varied considerably; from 21st to 25th very hot, the close of the month cool and showery. TSS on 9th and 17th. Wild strawberry in flower and oak in leaf on 11th.

HITCHIN.—The hottest May in 40 years' record, and the wettest but two.

WINSLOW, ADDINGTON.—A very favourable month, vegetation making rapid progress. No frost, not even on grass; the temp. rose to 80 twice, having reached that point only once before in May since 1871. There were two falls of R exceeding an inch, which caused very large floods, that on the 26th doing an immense deal of damage to the hay crop.

WEYMOUTH, LANGTON HERRING.—The R for the five months of this year is only 62 per cent. of the average, and less than in the corresponding period of any of the 13 previous years. Mean temp. at 9 a.m. for May 57°·3, the highest in May during 18 years, and 3°·7 above the average. The max. in shade on 24th has only once been exceeded in May in 17 years. Solar halos on 4th, 8th, and 12th. Slight TSS on 6th and 11th.

BODMIN.—On the whole a cold May, but a very bright enjoyable month.

UPFIELD, STROUD.—TSS on 5th and 24th; L on 6th, 17th, 23rd and 30th. On 24th, 26 in. of R fell within 15 minutes, and the TS was preceded by a great gust of wind, which blew down two or three trees.

WOOLSTASTON.—A warm genial month, very favourable for the hay crop, which promises to be heavy. Violent storms of T and L on 5th, 7th and 9th. Mean temp. 54°·8.

ORLETON.—The temp. and the weather were variable, with frequent TSS, followed by many cloudy and gloomy days. From 19th to 25th the weather was unusually bright and hot. Mean temp. nearly 2° above the average of 28 years. Fluctuations of pressure slight. TSS on 4 days and T on 7 days. The storm of the 24th was accompanied by large and destructive H. Cherry trees in full bloom about the 3rd, and apple trees about the 20th.

HULL.—With the exception of the 10th and 11th, the weather up to the 23rd was generally fine; from that date to the end of the month it rained more or less every day, often with T, and a heavy fall of H on 30th.

NORTH SHIELDS.—TSS on 4 days and T on 4 other days.

WALES.

HAVERFORDWEST.—The most genial May for many years, with an entire absence of frost in air, though white frosts occurred on the 10th and 14th. The oak was in leaf on the 15th and the ash had almost bare branches at the end of the month; no such disparity can be remembered. The R, though scarcely the average, was so distributed over the month as to secure, with the genial warmth, abundance of grass. Barley sowing late. Every description of tree in leaf exceptionally early, and if nothing unforeseen occurs there is every promise of a beautiful summer.

SCOTLAND.

CARGEN.—A remarkably fine and warm month, the warmest recorded during 30 years. Mean temp. 54°·5, or 3°·6 above the average. Sunshine 243 hours, or 23 hours above the average; the last week of the month was considerably cooler than the first 23 days. Vegetation made unusual progress, and corn, hay, and pastures never looked better at this season. All flowering trees and shrubs in bloom three weeks earlier than usual. E. and S.E. winds prevailed for 17 days.

JEDBURGH.—The weather during the month was remarkably fine ; the temp. was high and the result was a rush of vegetation that has not been equalled in May for a long series of years. All crops alike in garden and field look well and are far advanced.

CRAIGVARREN, ORAN.—A decidedly warm month, very free from E. winds and of equable temperature. R moderate ; growth making great progress, grass and foliage in particular both forward and abundant in quantity. Slight T on the 7th ; sheet L on the 14th.

QUINISH, MULL.—A warm dripping month, most favourable to growth. This spring season is the earliest and best that has been known for the last 25 years, being distinctly better than the remarkable one of 1878.

BRAEMAR.—The finest May on record, foliage and vegetation looking remarkably well and three weeks in advance of former seasons. Mean temp. 51°·7.

ABERDEEN.—The finest May experienced here for a great number of years.

LOCHBROOM.—The month in every respect could not be excelled so far as outdoor work is concerned, but followers of Walton complain. TS on 7th.

CULLODEN, INVERNESS.—The month was finer in all respects than any May for more than 20 years. E. winds and damaging frosts were entirely absent. R very small, but there were heavy dews at night and the growth of grass was constant, and the same can be said of corn crops and vegetation generally.

S. RONALDSAY, ROEBERRY.—The driest May since 1876.

IRELAND.

CORK.—On the whole a very propitious month, although the wettest May during 24 years, except 1869 and 1878. Mean temp. about the average. Total R to the end of May 15·93 in., which is 4·44 in. less than the average of 24 years.

WATERFORD.—R 1·01 in. above the average.

ROSS, O'BRIENSBRIDGE.—Excellent vegetation during the month. Frequently very warm and bright, with heavy dews and sufficient R. Mean temp. above the average of 10 years.

DUBLIN.—A very favourable month, singularly free from parching E. winds, with a high mean temp. and genial R. Atmosphere generally quiet and no gales. Solar halos on 16th and 20th. Foggy on 9 days, high winds on 5 days ; H on 31st. The mean min. on grass was 42°·4, compared with 37°·5 in May, 1888, and 37°·9 in May, 1887.

BALLINASLOE.—Wet, windy, and cold. TSS on 14th and 23rd.

FLOODS IN AUSTRALIA.

EXTRACT from a letter written by R. Humphrey Marten, M.B. Camb., of Adelaide, South Australia :—

“ April 22nd, 1889.

“ I wrote you on January 1st, saying our fearful drought had broken up, and it continues to break, and people say they can now believe in the history of Noah and the ark.

“ It began to rain on Sunday last, and continued in one steady downpour till Wednesday evening. In some places as much as 8½ inches fell in 24 hours, and the average throughout the colonies was over an inch in 24 hours. The floods came down our usually dry rivers in tremendous torrents, sweeping everything before them—man, beast, produce, bridges, all swept away—and even in our city the floods reached a dangerous height. We have a dam to uphold a lake in the river which flows through the city, and although the dam stood, it was rendered useless by the floods boring out a new course for the river. The oldest settlers never remember such rains, and everyone is jubilant about the glorious seasons it will lead to. All the dams and tanks throughout the country are full, and lakes have appeared inland where no such things were ever dreamt of.”

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCLXXXII.]

JULY, 1889.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE PARIS EXHIBITION AND ITS CONGRESSES.

IN 1878 we were able to begin our articles descriptive of the Paris Exhibition in our May number, but it would not have been wise to do so this year, owing to the backwardness of the exhibitors. Our notice of the exhibits, and of the utilization of the Eiffel Tower, must now stand over until the autumn. Meanwhile our French friends are very desirous that the Congresses, of which they have arranged a multitude, should be largely attended.

There are two which chiefly concern meteorologists—and, rather inconveniently, they are not consecutive—so that visitors must either make two journeys, give up one of the two Congresses, or remain in France from September 19th to October 10th, or 20th, if they stop for the excursion to the Thermal establishments in the Vosges.

The precise dates are :—

Meteorology, September 19th to 26th.

Hydrology and Climatology, October 3rd to 10th.

Excursion to health resorts, October 11th to 20th.

METEOROLOGY.

Members will consist of all persons interested in the science, and who send 12 francs to the President of the Congress, M. Renou, 7, Rue des Grands Augustins, Paris.

They will receive a card of admission to all the meetings during the week, and to the excursion, and a copy of the report of the papers read, and of the discussions upon them.

The programme of subjects to be discussed is quite alarming. Some persons might be tempted to say that it includes all branches of meteorology. It does not, but it certainly gives a remarkable proof of the development of this branch of science, and on that account we translate it *in extenso*.

Pressure.—On the reduction of barometer readings to sea level pressures. Verification of the relations between the barometric gradient and the velocity of the wind. Difference between the effects of equal gradients in summer and in winter.

VOL. XXIV.

G

Temperature.—Comparison between the temperature indicated on various thermometer stands and that shown by the *thermomètre fronde*. Decrease of temperature with altitude. Distribution of solar heat over the globe. Secular change of climate.

Wind.—Choice and graduation of anemometers. Results of recent measures of the vertical component of the wind.

Vapour.—Measure of the water in a liquid state suspended in the atmosphere. Accurate measure of evaporation from different surfaces.

Clouds.—Progress made in various countries in the observation of cirrus. Measurement of altitude of clouds. Cloud photography. Classification. Definition of nimbus.

Precipitation.—What progress has been made in the measurement of very slight rains, and of dew. Rainfall at sea. Study of floods, and of warnings against them, in various countries.

Influence of cosmic phenomena.—Lunar and solar atmospheric tides. Influence of sunspots on meteorological phenomena. Lunar influences.

Weather forecasting.—Researches destined to improve it.

Various.—Measure of the intensity of solar radiation. Actinometry. Polarisation of the atmosphere. Transparency of the atmosphere for various rays of the spectrum. Scintillation of the stars. Optical phenomena.

Magnetism.—Relation between magnetic phenomena and earthquakes. Magnetic disturbances and sunspots. Study of earth currents. Magnetic observations at sea.

Electricity.—Modes of observing atmospheric electricity. Relations between electricity and other meteorological phenomena. Aurora.

Storms.—Recent progress in the study of. Barometric oscillations during.

Applications of Meteorology.—Relation between meteorological phenomena and phenological phenomena. The migration of birds and appearance of insects. Application of meteorology to agriculture and to hygiene.

Our verdict upon this programme is, that if it be carried out, the members will have to be carried out also, and will certainly have to spend the interval between it and the Hydrological Congress on October 3rd, under medical care. In fact, it will be only the trip to the Vosges, October 11th to 20th, which will restore them to mental equilibrium. The programme cannot be fully carried out, but it is useful as indicating the field outside of which the discussions must not wander.

HYDROLOGY AND CLIMATOLOGY.

THIS is the second meeting of the Congress, of which the first was held at Biarritz in October, 1886. We yield to no one in our esteem for M. Renou, the director of the Parc St. Maur Observa-

tory, but we cannot help thinking that somebody has imposed too much on his good nature, in asking him this year to preside over this congress as well as over that upon meteorology. Of the Meteorological one, he, as President of the Meteorological Society, could hardly refuse the Presidency, but we cannot help thinking that it is, as we say, "working the willing horse too hard" to have thrown the Hydrological Congress also upon him.

The general arrangements are much the same as for the Meteorological Congress, except that members have to send 20 francs instead of 12, and that the 20 francs has to be sent to M. Doin, 8, Place de l'Odéon, Paris, and that it is proposed to circulate *in advance* printed copies of the papers to be discussed.

The programme of subjects for discussion is very much shorter than that for the Meteorological Congress; it is divided into three sections, of which we omit the one dealing with Medical Hydrology.

Scientific Hydrology.

1. Precautions necessary for determining accurately the temperature of thermal springs.
2. Relations between mineral waters and geological formations.
3. On micro-organisms in mineral waters, and their influence on the composition and properties of those waters.
4. On the influence of theories as to microbes on thermal therapeutics.
5. On the origin of the gas contained in mineral waters, and on the share which it has in their properties.
6. On the vapours escaping from mineral waters, and on their transformations.
7. Programme of instruction in Hydrology.

Climatology.

1. Conditions which should govern the establishment of a Meteorological Observatory established chiefly for medical purposes.
2. Organization for announcing coming weather at health resorts; rules for weather forecasting.
3. Climatology of various health resorts.
4. Comparison and classification of health resorts according to their climate.
5. On the action of mountain climates on affections of the lungs.
6. On the action of maritime climates in tubercular affections.
7. Programme of instruction in Climatology.

The general meetings will be at the Trocadéro, the sectional ones at the Faculté de Médecine; the latter will usually last from 9 a.m. till noon, and from 2 till 5 p.m.; during the week there will be an excursion to Pierrefonds and Compiègne, and two others, one to Enghein and the other to the Observatory at Parc St. Maur.

On October 11th will commence an excursion of nine days in the Vosges, starting from Nancy, and visiting, among other places,

Plombières, Luxeuil, Contrexéville and Bourbonne-les-bains. As was the case with the excursion to the Pyrenees, the railway companies will allow members to travel at half-price.

We ought not to omit to state that, as regards this congress and excursion, it is expressly stated that ladies can qualify as members by the same payment as gentlemen, and will enjoy similar rights and privileges.

THE DORSETSHIRE WATERSPOUT OF JUNE 7TH.

Thanks to the Rev. H. J. Poole, of Stowell Rectory, Somerset, who has visited the district, photographed some of the damage, and favoured us with copies, and with notes of what he saw, we are able to add considerably to the note on page 75 of our last number and to give a compact account of what occurred.

In Dorsetshire, 15 miles North of Weymouth, and 12 miles inland from the English Channel, near Bridport, is the small town of Cerne Abbas, which is to be found on almost every map. About two miles N. of Cerne Abbas there is a range of hills running generally W.-E., and from the Northern slope of these hills several small streams flow, which eventually form the river Yeo, which passes Yeo-vil, joins the Parrett, and finally discharges into the Bristol Channel. The highest point on these hills is known as High Stoy, and that it is a commanding position is proved by its having formerly been a station for one of the old semaphores—the word “telegraph” remaining on the Ordnance Map.

It was close to this that the waterspout fell. *The Times* reporter said, “It has now been ascertained that a waterspout burst on Batcombe Hill.* An eye-witness described it as a solid stream of water of about the thickness of a man’s body. It tore up the ground to a considerable depth, and forced a channel for its escape down the hillside.” Mr. Poole had evidently never before seen the effects of a waterspout, and, while recording with strict accuracy what he saw, was rather puzzled. He approached High Stoy from the west, and says, “The road all the way up was much washed, deep pits occurring at intervals. About 7 or 8 ft. below the summit, or plateau of High Stoy, I found the deepest excavations of all; they were then (June 18th) filled in, but the roadmen assured me that they were 8 or 9 feet deep. The road was slightly washed above these pits, and the course of the torrent could be so far easily traced, but above and around them there was not the slightest trace of any disarrangement of the soil. The mystery is—supposing that this was a very heavy fall of rain in a thunderstorm, the water concentrating

* Batcombe is a village at the foot of Batcombe Hill, the eastern extremity of which is sometimes called Batcombe Hill, sometimes (and more appropriately) High Stoy.

at the union of the two combs down which it poured—how came these deep pits very nearly at the summit ? ”

Evidently the facts are, as Mr. Poole points out, quite inconsistent with the effects of a heavy rain, which would cause most mischief where the water was brought together by the configuration of the country—but though there was very heavy rain—perhaps 4 or 5 inches—that would not tear holes 8 or 9 feet deep in a road on the flat top of a hill. Such damage is by no means rare—a closely parallel case in Yorkshire is described in the *Meteorological Magazine* for July last (p. 84)—and there is no doubt that *The Times* correspondent's statement as to the “solid stream of water about the thickness of a man's body” is strictly correct. It is only by such a column of water as he describes that these holes can be excavated, and there is no doubt that over the small area (probably less than a yard across, but moving) the fall of water would have to be measured, not by inches, but by feet or yards; most of the water ran away northwards, but some southwards through Minterne and Upcerne, where damage occurred.

Mr. Poole followed the Northern portion, which went through Batcombe and Heniford to Chetnole, and he has sent us interesting photographs of the damage. At Batcombe the rush of water undermined the front of a cottage, so that it had to be shored up, and the pig sty at the end was completely washed away. About a mile further down the stream was Heniford Mill, the damage to which was reported in our last. A mile further is the village of Chetnole, and there the very well-built garden wall perhaps 100 feet in length, of Major Digby's house, was thrown over in large masses, and a greenhouse overturned.

The nearest rain gauge stations to the High Stoy are Cattistock Lodge, which is five miles S.W.; Melbury, which is five miles W.N.W.; and Hazelbury Bryan, which is seven miles E.N.E. of High Stoy—we have the pleasure of adding at the end reports from the observers at these stations. It is much to be regretted that the Rev. H. Pix, who used to observe at Minterne, removed from there in 1887, and did not succeed in finding any one to continue the record, otherwise that would have been the nearest station, being within a mile of High Stoy.

There are just two remarks which we desire to add in concluding our notice of this subject.

(1) That Mr. Poole's visit, photographs and report, well illustrate the excellent service which the widely-distributed rainfall observers can and do render to the progress of knowledge.

(2) That it is much to be regretted that no record seems to have been preserved as to whether the water was fresh or salt. Our impression is that it was probably sea water lifted from the English Channel by a whirlwind, and dropped upon the top of High Stoy.

SIR,—I am sending a report of the very big rainfall of Friday last, the 7th of June. The thunder and lightning were incessant, accompanied by torrents of rain lasting for three hours, from 2.45 till 5.45 p.m., when I ventured out to measure the fall, it being no less than 3.78 inches; for the 24 hours ending Saturday morning the fall was 3.84 inches. This is an accurate report; no one could be more precise in measuring.

I may mention that it was about four miles from here, where a waterspout burst on Batcombe Hill the same day, as reported in the *Standard* of Monday last.

ARTHUR CHAPPLE.

Cattistock Lodge, Dorchester, June 14th, 1889.

P.S.—I forgot to say that the fall for the 24 hours ending at 8 o'clock Friday morning 7th, was .96 in.; as no rain fell on Thursday, 6th, till after 6 p.m., more than $4\frac{1}{2}$ inches of rain fell in the 24 hours ending 6 p.m. on 7th.

SIR,—In answer to your enquiry as to the fall of rain here at the beginning of June it was :—

June	1st	.....	in.	
	1st	.....	.18	
	6th	.....	.20	Thunder and lightning.
	7th	.....	.32	" "
	9th	.....	.20	" "
	10th	.....	.07	
	11th	.....	.03	
			1.00	

No more afterwards up to the present time. We had continuous thunder and lightning all through the 6th and 7th, and on the latter it was considered somewhat fearful, but we had not torrents of rain as at Batcombe, &c. High Stoy is at the north or north-east end of Batcombe-hill, a road runs along the top from Evershot station to Minterne. The hill, as seen on the western side, has a sharp-edged appearance, but on the top it is strikingly flat for a considerable distance; towards Batcombe village (which lies in a curve at the bottom) the top narrows. On the other and Cerne Abbas side is a steep, narrow valley leading to Sydling. Traces of the storm are all about; the road leading down to Batcombe village was quite impassable in the lower parts; great holes washed out, the size of some of the stones, too, quite surprising.

T. C. ELLIOTT.

Melbury House Gardens, July 6th, 1889.

SIR.—The rainfall here on June 7th was less than an inch, .95 in.

R. F. WHEELER.

Hazelbury Bryan.

THE DROUGHT.

THE general table on page 94 is peculiar, in that not one station in the British Isles had its average rainfall in June. Generally a dry month in one part of the British Isles is a wet one in another. But here we have Seathwaite with very little more than half as much as London, and a dry month everywhere. We append a few letters from correspondents in very widely scattered localities, and at the end of them a few cuttings illustrative of the effects of the drought.

CAMDEN SQUARE, LONDON.—There was from the 16th of June until July 7th, an absolute drought of 22 days—the only longer ones since 1857 have been 1863, June 27th to July 20th, 24 days; 1865, June 4th to June 28th, 25 days; 1880, March 8th to March 30th, 23 days; 1880, August 9th to September 5th, 28 days; 1887, June 9th to July 3rd, 25 days.—G. J. SYMONS.

INGLESIDE, KENLEY, SURREY.—I herewith send you particulars of a dry period here which has just terminated, and which may be interesting to you.

	in.	
June 11th.....	·02	
„ 15th.....	·03	
July 7th.....	·01	21 days absolute drought.
„ 8th.....	·10	
„ 9th.....	·33	28 days ·16.

The dry period has been very favourable for the hay gathering, the crop of which is said to be larger, and obtained in better condition, than for 20 years.—HAROLD SMITH.

TENTERDEN.—The three weeks from June 16th to July 6th were absolutely rainless, except for a little moisture on July 3rd, which did not give ·005 in. Last night we had ·30 in., and on 7th and 8th, ·13 in. and ·10 in. The drought was beginning to be felt at last. Only ·91 in. in June, and 1·30 in. in May, giving a total less than in 1887, and nearly as small as in 1870, though 50 per cent. more than in 1868 and 1884. Three days with temp. above 80° in June, more than I have had since 1881.—J. ELLIS MACE.

SEDGEBROOK, NORTHAMPTON.—From June 10th to July 8th there was here a partial drought, the amount of rain being only ·10 in., which fell on two days; and from May 29th to July 8th the total fall was only ·65 in. This is the longest drought here since 1887, when there was an absolute drought from June 4th to July 3rd, and from June 4th to July 13th a partial drought, for only ·15 in. fell. During the period mentioned, this year, there was no great heat, the highest shade temperature being 78°·9, and the weather uniformly pleasant.—C. A. MARKHAM.

BLOFIELD, NORWICH.—Rainless from June 11th to July 6th, both inclusive; only ·01 in. on 7th, and no rain on 8th; ·48 in. on 9th closed the drought.—A. W. PRESTON.

BECKFORD, TEWKESBURY.—The welcome rain has come at last, terminating the drought, which has lasted just a month. From June 11th to July 8th, both inclusive, or for a period of 28 days, no rain fell at Beckford.

This is almost equal to the absolute drought in 1887, when we had 31 consecutive rainless days.—FREDK. SLADE.

ROTHERBY HALL, LEICESTER.—Total rainfall June, 1889, .59 in. Driest June in previous 20 years, 1874, .64 in.—J. HAINES.

FOX HILL, FRODSHAM.—I give particulars of the rainfall, as it is the smallest in any month that I have recorded in the 16 years I have kept a gauge—June 1st, .18 in. ; 2nd, .08 in. ; 8th, .10 in. ; 9th, .03 in. ; total, .39 in.—JAMES REYNOLDS.

ALEXANDRA PARK, MANCHESTER.—June was remarkably dry, and the authorities are beginning to be anxious about the water supply, and have already recommended the greatest economy.—J. CASARTELLI.

HURST BANK, HEATON, BOLTON.—The longest drought, or rather the longest period with the least rainfall, registered by me since I commenced taking the rainfall in 1863, has just come to an end.

On the 1st and 2nd June .58 in. fell—chiefly during a TS from 7.45 to 8.15 a.m. on the 2nd—after which day, until the 9th July, only .09 in. fell, namely, .03 in. on the 8th, and .03 in. on the 14th June, and .03 in. on the 6th July. An absolute drought reigned from 15th June to 5th July inclusive—21 days; and a partial one from June 3rd to July 8th inclusive—36 days, during which only only .09 in. fell.

The rainfall on the 9th July was .32 in., with every prospect of a continuance.

The next longest drought was in 1887, when, from June 4th to July 8th inclusive—35 days—only .21 in. fell, and there was an absolute drought from June 9th to July 3rd inclusive—25 days.—JAMES WATKINS, F.R.MET.SOC.

PAWSTON, CORNHILL-ON-TWEED.—June proved an unusually dry month, beating even the record of the Jubilee year. After the thunderstorm of the 2nd, only .23 in. of rain fell up to July 3rd; all pastures are much burnt, and corn prospects have been very much spoilt by the three weeks or so of drought.—B. P. SELBY.

TREVALYN HALL, WREXHAM.—The period of drought, which has now terminated, has been unusually protracted, and absolute for 25 days. I therefore send you the rainfall for last month and up to the present date, showing that, with a very slight exception (on June 13th), an absolute drought prevailed here from June 8th to July 9th, a period of 30 consecutive days. It has been a glorious time for securing the hay crop, which, owing to a wet April and a showery May, has been very abundant. We had a remarkable hail-storm on June 2nd, the hail consisting of very large and irregularly-

shaped cubes of ice, which caused much destruction to greenhouses in this locality.—B. T. GRIFFITH-BOSCAWEN.

Rainfall at Trevalyn Hall, Rossett, Denbighshire. Above sea level, 58 feet.

		in.	
June	1st.....	·16	
	2nd	·30	Thunder and hail, 3 p.m.
	8th	·12	
	13th	·02	
July	9th	·09	Bar. falling and drought apparently terminated.
Total fall in 39 days		·69	

BLACKET PLACE, EDINBURGH.—No rain fell here from June 15th to July 2nd, and only ·08 in. in 27 days.—R. C. MOSSMAN.

BUSHY HILL, CAMBUSLANG.—I send note of drought and rain-fall :—

Absolute drought from June 15th till July 5th, both inclusive—20 days—0·00 in.

Partial drought from June 3rd till July 8th, both inclusive—36 days—0·11 in.

0·83 in. of rain fell on 2nd June, 0·60 in. on 9th July from 5 p.m. till 9 a.m. of the 10th.—HENRY MUIRHEAD.

SCARCITY OF WATER AT GLOSSOP.—The extensive paper mills belonging to Messrs. Olive and Partington, at which a large number of hands is employed, will be stopped shortly if the present fine weather continues, owing to scarcity of water.—*Sheffield Independent*, June 28th.

SCARCITY OF WATER AT GLOSSOP.—A large number of employés at Captain Partington's extensive paper mills, Glossop, are working only three and four days a week, owing to the scarcity of water, and it is stated that, if the present drought continues much longer, it is probable the whole of the hands will have to work short time. Other large mills in the town are seriously affected by the dry season.—*Sheffield Telegraph*, July 5th.

LANCASHIRE AND DISTRICT.—The prolonged dry weather is causing much anxiety to those connected with the supply of water to the public in this district. At Manchester particularly is this the case, and the continuance of the drought is beginning to tell heavily upon the supply in store, the springs which feed the reservoirs being at a very low ebb indeed. The consumption, on the other hand, seems to be increasing daily, and reaches as much as seven million gallons per day in excess of the quantity consumed under ordinary conditions. Still, there is a very fair quantity in store, and up to now the Water Works Committee have not thought it needful to limit the supply in any way. In some of the outer districts of Rochdale the supply is giving out, and the inhabitants have to resort to wells and springs, which are generally available as a last resource.

In some parts of Cheshire also much inconvenience is being met with, while in North Wales several quarries are at a standstill owing to the lack of water to work the machinery used. Unless rain speedily falls, some thousands of men employed at the quarries will be thrown out of employment. Altogether matters are getting serious, and a smart downfall of rain would be hailed with satisfaction throughout the district, especially as the farmers have practically got their hay safely barked.—*Gas and Water Review*, July 6th.

WATER FAMINE IN CHESHIRE.—Owing to the protracted drought, no rain having fallen since the hail and rain storm a month back, there is a water famine in all the Cheshire villages which depend upon local or irregular supplies. At Saughall a meeting of residents is summoned to consider the question, as wells and water pits are all dried up.—*Notts Daily Guardian*, July 18th.

THE DROUGHT IN LINCOLNSHIRE.—The continued absence of rain is causing serious misgivings respecting the crops in Lincolnshire. No rain has fallen for over a month, and the growing crops are sadly in need of moisture. The roots are especially suffering, and it is feared, if the dry weather continues much longer, the mangolds and turnips will be a failure. In many parts of the district the dykes and ponds are rapidly drying up, and farmers are in some instances under the necessity of carting water to their cattle.—*Sheffield Telegraph*, July 10th.

ROYAL METEOROLOGICAL SOCIETY.

THE last meeting of this Society for the present session was held on June 19th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. T. J. Moss-Flower, Mr. A. H. Halder, Mr. R. A. Naylor, and Mr. C. B. Penlington were elected Fellows.

Mr. W. Marriott gave an interesting account of the thunderstorms which prevailed over the country during June.

On Sunday, June 2nd, a thunderstorm passed in a northerly direction from Wiltshire about 3 a.m., and reached Edinburgh by 10.44 a.m. It travelled at the rate of about 50 miles an hour. It is possible that this storm travelled still further north, and reached Kirkwall at 3.37 p.m. A severe thunderstorm prevailed over the neighbourhood of the Tweed between 11 a.m. and noon, and was accompanied by hail of very large size, some of the stones being five inches in circumference. A very destructive storm occurred over the whole of the North-west of England and South of Scotland during the afternoon of the same day; much damage was caused by lightning, and very large hail fell over an extensive area. Some of the hail-stones measured seven inches in circumference and weighed seven

ounces. During the night of the same day a severe thunderstorm prevailed over Norfolk, which was also accompanied by very large hailstones, some of which were five to six inches in circumference.

On Thursday, the 6th, thunderstorms prevailed during the afternoon over the whole of the South-east of England. That which passed over the Metropolis about nine o'clock was remarkable for the brilliant and continuous display of lightning. During the same night, and in the early morning of the following day, a very destructive storm prevailed over the Eastern Counties, much damage being done by the lightning in the North-west of Norfolk. Severe hailstorms occurred between 2 and 3 a.m., both at Margate and Ipswich.

During the afternoon of the 7th, destructive thunderstorms prevailed over the whole of the Southern Counties, much damage being done by lightning, while at Tunbridge Wells there was a most remarkable hailstorm. One of the hailstones, which was weighed, was actually half-a-pound in weight.

An interesting collection of more than 40 photographs of lightning taken during the storm on June 6th was exhibited to the meeting. In addition to the sinuous, ribbon and meandering flashes of lightning, several photographs showed knotted, multiple and dark flashes.

The following papers were also read :—

"The Climate of British North Borneo," by Mr. R. H. Scott, M.A., F.R.S.

"On the Variation of the Temperature of the Air in England during the period 1849 to 1888," by Mr. W. Ellis, F.R.A.S., F.R.Met.Soc.

"Atlantic Weather and Rapid Steamship Navigation," by Mr. C. Harding, F.R.Met.Soc.

"Meteorological Phenomena observed during 1875-87 in the neighbourhood of Chelmsford," by Mr. Henry Corder.

"Rainfall in China, and Meteorological Observations made at Ichang and South Cape in 1888," by Dr. W. Doberck, F.R.Met.Soc.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, DECEMBER, 1888.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	58·9	5	25·9	31	46·2	36·2	38·5	91	69·9	19·2	1·29	9	5·6
Malta	71·2	1	43·7	9	63·2	53·9	50·1	79	117·4	36·5	1·67	7	6·4
<i>Cape of Good Hope</i>	92·5	25	50·2	28	75·2	58·9	...	...	...	...	1·23	6	5·2
<i>Mauritius</i>	85·0	18	66·0	18	82·3	72·4	69·4	79	137·3	59·3	12·64	23	7·1
Calcutta	79·2	1	51·3	26	75·0	54·6	53·4	60	130·6	41·5	·00	0	0·6
Bombay	90·4	18	67·0	30	86·0	71·3	65·0	64	136·6	52·4	·00	0	0·8
Ceylon, Colombo	91·0	18	69·8	31	85·4	72·6	70·0	78	150·5	65·6	6·93	11	6·7
<i>Melbourne</i>	96·4	26	47·2	2	78·6	56·2	54·6	66	149·4	34·7	2·72	9	5·2
<i>Adelaide</i>	107·5	25	48·9	22	86·8	62·9	51·7	45	155·4	42·7	·28	8	4·2
<i>Wellington</i>	71·0	24	44·3	14	64·0	50·3	50·5	78	140·0	34·0	2·43	14	4·0
<i>Auckland</i>	75·0	23	43·0	14	66·6	52·4	48·3	67	139·0	36·0	1·26	9	5·0
Jamaica, Kingston	93·5	3	66·1	15	89·3	70·1	69·7	76	...	...	1·11	...	...
Barbados	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	46·7	25	0·0	22	35·7	23·1	25·3	78	...	—10·0	·83	22	8·1
New Brunswick, Fredericton	50·3	27	— 7·6	14	29·9	12·4	20·2	78	...	...	3·59	16	6·7
Manitoba, Winnipeg ...	35·2	4, 9	—14·0	13	22·1	2·3	12·3	90	...	...	·48	10	4·8
British Columbia, Victoria	59·0	3, 4	26·0	24, 25	48·2	37·7	...	...	...	...	1·96	13	...

REMARKS, DECEMBER, 1888.

MALTA.—Mean temp. 57°·7; mean hourly velocity of wind 9·8 miles. Sea temp. fell from 65°·4 to 62°·1. TS on 19th; L on 4th and 27th. R only half the average. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4 below, of dew point 1°·7 above, and R 6·83 in. above their respective averages. Mean hourly velocity of wind 9·3 miles, or 2·0 miles below average; extremes 19·8 on 8th and 2·0 on 21st. Prevailing direction, E. by N. T on 3rd, 24th, and 31st. T and L on 30th. Inundation in some parts of the island on 28th. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 3°·2, of dew point 4°·0, humidity 1, R ·23 in., and pressure ·070 in. above average; mean amount of cloud 0·4 below average. Prevailing winds S.E. and S.; strong on 8 days. Very sultry and oppressive on 9 days. T and L on 13th, and heavy TS on 31st. R. L. J. ELLERY, F.R.S.

Adelaide.—The hottest December, with one exception, on record, the mean temp. being 3°·8 above the average; the hottest Christmas-day ever known in Adelaide. Mean min. considerably higher than any previously recorded. R one-third of the average. On the 31st the drought had commenced to break up in the far N. and extreme W., and on January 1st, 1889, some of the heaviest floods recorded were experienced over the colony generally. Total fall of R for the year 14·57 in., one of the smallest amounts on record, the fall having been less in only three years since the foundation of the colony. C. TODD, F.R.S.

Wellington.—Fine weather generally, but strong winds from W. and N.W.; showery at the commencement, during the middle, and at the end of the month, but the total rainfall small. Distant T and L on 9th. Mean temp. 3°·6 and R 1·51 in. below the average. R. B. GORE.

Auckland.—An unusually cold month, the mean temp. being 5° below the average. R not half the average; pressure rather above the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
JUNE, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	1.00	XI.	Castle Malgwyn	.71
„	Margate, Birchington...	1.61	„	Rhayader, Nantgwillt..	.99
„	Littlehampton	.88	„	Carno, Tybrith	.46
„	Hailsham	.24	„	Corwen, Rhug	.66
„	Ryde, Thornbrough	.66	„	Port Madoc	.57
„	Alton, Ashdell	.92	„	I. of Man, Douglas	.36
III.	Oxford, Magdalen Col...	1.90	XII.	Stoneykirk, Ardwell Ho.	.90
„	Banbury, Bloxham	1.31	„	New Galloway, Glenlee	.86
„	Northampton	.88	„	Melrose, Abbey Gate...	.98
„	Cambridge, Beech Ho...	2.41	XIII.	N. Esk Res. [Penicuik]	1.50
„	Wisbech, Bank House..	1.26	XIV.	Ballantrae, Glendrishaig	.49
IV.	Southend	2.10	„	Glasgow, Queen's Park.	.91
„	Harlow, Sheering	1.35	XV.	Islay, Gruinart School..	.91
„	Rendlesham Hall	4.22	XVI.	Dollar	.64
„	Diss	1.41	„	St. Andrews, Pilmour Cot	.82
„	Swaffham	1.86	„	Balquhiddier, Stronvar..	1.56
V.	Salisbury, Alderbury ...	2.26	„	Dunkeld, Inver Braan..	.56
„	Warminster	2.61	„	Dalnaspidal H.R.S.	1.13
„	Bishop's Cannings	1.23	XVII.	Keith H.R.S.	.82
„	Ashburton, Holne Vic...	.41	„	Forres H.R.S.	.32
„	Hatherleigh, Winsford.	.71	XVIII.	Strome Ferry H.R.S....	.76
„	Lynmouth, Glenthorne.	.74	„	Fearn, Lower Pitkerrie.	.64
„	Probus, Lamellyn	.86	„	Loch Shiel, Glenaladale	...
„	Launceston, S. Petherwin	.65	„	N. Uist. Loch Maddy ...	1.35
„	Wincanton, Stowell Rec.	.99	„	Invergarry	.30
„	Taunton, Lydeard Ho...	.57	„	Loch Ness, Drumnadrochit	.33
„	Wells, Westbury	.68	XIX.	Lairg H.R.S.	.97
VI.	Bristol, Clifton	.51	„	Fornard H.R.S.	...
„	Ross	.41	„	Watten H.R.S.	.70
„	Wem, Clive Vicarage ...	.51	XX.	Dunmanway, Coolkelure	1.67
„	Cheadle, The Heath Ho.	.57	„	Fermoy, Gas Works ...	1.96
„	Worcester, Diglis Lock	.97	„	Tipperary, Henry Street	1.64
„	Coventry, Conndon	1.05	„	Limerick, Kilcornan ...	.68
VII.	Ketton Hall [Stamford]	.73	„	Miltown Malbay	1.06
„	Grantham, Stainby	.36	XXI.	Gorey, Courtown House	.26
„	Horncastle, Bucknall ...	.52	„	Navan, Balrath	.00
„	Mansfield, St. John's St.	.59	„	Mullingar, Belvedere ...	.83
VIII.	Neston, Hinderton	1.18	„	Athlone, Twyford	1.49
„	Knutsford, Heathside ...	.66	„	Longford, Currygrane...	.98
„	Lancaster, South Road.	1.61	XXII.	Galway, Queen's Coll...	1.05
„	Broughton-in-Furness ..	1.75	„	Clifden, Kylemore	2.41
IX.	Wakefield Prison	.46	„	Crossmolina, Enniscoe..	1.67
„	Ripon, Mickley	.35	„	Collooney, Markree Obs.	.89
„	Scarborough, West Bank	.37	„	Ballinamore, Lawderdale	.77
„	East Layton [Darlington]	.22	XXIII.	Warrenpoint	.03
„	Middleton, Mickleton ..	.14	„	Seaforde	.41
X.	Haltwhistle, Unthank..	.83	„	Belfast, New Barnsley ..	.53
„	Shap, Copy Hill	2.31	„	Bushmills, Dundarave...	.78
XI.	Llanfrechfa Grange	.77	„	Stewartstown	.34
„	Llandoverly	.78	„	Buncrana	.78

JULY, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				In shade. No. of Nights below 32°
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Days on which 01 or more fell.	Max.		Min.			
				Dpth.	Date.		Deg.	Date.	Deg.	Date.		
		inches.	inches.	in.								
I.	London (Camden Square) ...	2.64	+	.17	.86	21	17	80.9	5	46.1	19	0
II.	Maidstone (Hunton Court)...	2.36	+	.32	.50	16	16	...	...	...	...	...
III.	Strathfield Turgiss	2.19	—	.11	.55	21	20	79.0	6, 30	44.9	24	0
	Hitchin	4.30	+	1.60	2.10	12	15	74.0	6, 30	46.0	18	0
IV.	Winslow (Addington)	2.74	+	.14	.51	13	14	80.0	6, 30	41.0	19	0
	Bury St. Edmunds (Culford) ..	...	...	...	...	...	...	...	...	...	...	...
V.	Norwich (Cossey)	3.10	+	.35	.77	21	15	78.0	1	44.0	24	0
	Weymouth (Langton Herring) ..	2.18	—	...	.51	10	15	74.0	12	48.0	17	0
VI.	Barnstaple	3.44	—	.11	1.08	8	15	77.5	6	48.0	2	0
	Bodmin	3.87	+	.43	.91	8	17	...	...	...	...	...
VII.	Stroud (Upfield)	4.04	+	1.20	2.38	13	16	81.0	6a	53.0	24	0
	Church Stretton (Woolstaston) ..	3.68	+	.65	1.13	13	16	76.5	6	45.0	19	0
VIII.	Tenbury (Orleton)	2.22	—	.69	.68	13	12	80.8	6	37.0	19	0
	Leicester (Barkby)	1.89	—	.85	.49	13	19	85.0	6	37.0	16	0
IX.	Boston	1.69	—	.84	.70	13	11	90.0	5	43.0	8	0
	Healey Hall (Tickhill)	1.71	—	...	.43	10	14	81.0	31	40.0	24	0
X.	Manchester (Plymouth Grove) ..	3.14	—	.56	.64	21	17	81.0	30	42.0	7	0
XI.	Wetherby (Ribston Hall) ...	1.59	—	1.02	.32	25	9	...	...	...	...	...
	Skipton (Arnccliffe)	3.97	—	.98	.73	24	16	83.0	6	36.0	8	0
XII.	Hull (People's Park)	1.38	—	1.44	.32	9, 10	14	...	...	...	...	...
	North Shields	2.88	+	.33	.61	25	15	78.5	6	41.5	8	0
XIII.	Borrowdale (Seathwaite)	5.78	—	2.99	1.13	24	15	...	...	...	...	...
	Cardiff (Ely)	4.23	+	.41	1.03	9	14	...	...	...	...	...
XIV.	Haverfordwest	2.62	—	1.31	.56	9	13	77.0	31	45.3	11	0
	Plinlimmon (Cwmymlog) ...	4.24	—	...	.80	13	12	...	...	...	...	...
XV.	Llandudno	1.91	—	.80	.50	23	12	73.6	31	45.7	24	0
	Cargen [Dumfries]	3.76	+	.63	.98	10	14	76.8	31	39.0	8	0
XVI.	Jedburgh (Sunnyside)	3.86	+	.93	.93	10	15	77.0	31	40.0	9, 24	0
	Old Cumnock	3.12	+	.02	.87	10	16	81.0	31	33.0	7	0
XVII.	Lochgilhead (Kilmory)	.92	—	3.62	.23	24	11	...	...	...	...	...
	Oban (Craigvarren)	1.27	—	...	.39	10	12	75.2	4	46.6	18	0
XVIII.	Mull (Quinish)	1.62	—	...	.47	24	16	...	...	...	...	...
	Loch Leven Sluices	2.00	—	1.05	.50	11	7	...	...	...	...	...
XIX.	Dundee (Eastern Necropolis) ..	2.55	—	.24	1.05	24	10	77.1	6	38.9	18	0
	Braemar	1.77	—	1.09	.65	24	16	76.0	4	36.0	24	0
XX.	Aberdeen (Cranford)	3.41	—	...	.73	15	19	70.0	30	40.0	23	0
	Lochbroom	1.27	—	...	.32	16	12	...	...	...	...	...
XXI.	Culloden	1.57	—	1.21	...	...	...	78.0	31	41.0	3	0
	Dunrobin	1.34	—	...	.38	19	10	68.5	31	40.0	12	0
XXII.	S. Ronaldsay (Roeberry)	1.05	—	1.56	.34	7	11	65.0	30	43.0	12	0
	Cork (Blackrock)	1.54	—	1.30	.47	22	8	80.0	1	42.0	12	0
XXIII.	Dromore Castle	2.20	—	...	.47	24	13	76.0	17	44.0	16	0
	Waterford (Brook Lodge)	2.42	—	...	.58	19	15	78.0	6	43.0	11	0
XXIV.	O'Briensbridge (Ross)	2.26	—	...	.74	24	13	77.0	4	48.0	27	0
	Carlow (Browne's Hill)	2.09	—	.47	.47	16	14	...	...	...	...	...
XXV.	Dublin (Fitz William Square) ..	2.57	+	.15	.62	22	15	77.8	6	44.0	8	0
	Ballinasloe	1.91	—	.97	.45	24	11	71.0	2, 3	38.0	7	0
XXVI.	Waringstown	3.82	+	.24	1.55	10	15	81.0	6	39.0	7	0
	Londonderry (Creggan Res.) ..	3.33	—	...	.86	10	19	...	...	...	...	...
XXVII.	Omagh (Edenfel)	2.69	—	.56	.62	10	17	74.0	6	41.0	7	0

a And 29, 30. b And 22.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON JULY, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—TS on 21st and 23rd. T on 26th.

ADDINGTON.—The early part of the month was very fine, but R began on the 9th, and the showery weather which continued until nearly the end made the securing of the hay crop very tedious. R was, however, much needed, and of great benefit to both grain and root crops as well as meadow land. Frequent T and heavy R at times.

LANGTON HERRING.—R 10 in. below the average. Mean temp. nearly equal to the average of 17 years. From June 14th to July 6th no R fell, giving an absolute drought of 22 days.

UPFIELD, STROUD.—Severe TS with heavy R from 3.30 to 5.30 p.m. on 13th; two trees struck by L within a mile.

WOOLSTASTON.—The long period of dry weather broke up on the 8th, and the remainder of the month was showery, R falling very heavily on 13th. TS on 23rd. Mean temp. 58°·4.

ORLETON.—The first 6 days were warm and dry, with a temp. above the average; from the 7th to the 29th there was generally much cloud during the days and the nights were clear and cold. It became warm again on the 30th, but the mean temp. was about 2°·3 below the average of 28 years, and was lower only in 1862, 1879, 1883 and 1888. The long drought (28 days without measurable rain) broke up on the 9th, and there were frequent falls of steady R after, with distant T occasionally, but no heavy storms. Distant T was heard on the 11th, 13th, 17th, 21st and 23rd. The bar. was very steady during the month, but below the average.

BARKEY.—Corn harvest just beginning at the end of the month. Hay harvest not completed in parts. Agricultural matters very fairly promising. T on 7 days.

WALES.

HAVERFORDWEST.—The first seven days, fine, dry and warm; from the 8th to 12th wet and showery; very close from the 12th to the 18th; cooler, but fine and dry with bright sunshine from the 19th till towards the end of the month, and the last three days warm, especially the 31st, which so far was the warmest day of the present summer. All crops look well, particularly oats and barley, but owing to the small R, potatoes and turnips are rather a failure as regards quantity. Temp. about the average; wind mostly N. and N.W., with some days S.W. to S.S.E. On the whole a fine summer month; temp. at or above 70° on 10 days. No T or L.

SCOTLAND.

CARGEN.—With the exception of a few warm days at the commencement and end of the month the temp. was unusually low, the mean from the 7th to the 25th inclusive being only 53°·1 or about 1° above the mean temp. of Sept., and the mean for the month 2°·1 below the average. The heaviest falls of R were generally accompanied by T, and were very partial. In the district 4·00 in. of R was reported to have fallen in less than two hours on the 11th near Thornhill, 14 miles N. of Dumfries. TS on 10th, 13th and 16th.

JEDBURGH.—The weather was all that could be desired by almost everyone. The R in the early days of the month was of singular importance to cereal and root crops, which were in excellent condition at the close. The grain cutting promises to be fully a fortnight earlier than last year.

CRAIGVARREN, OBAN.—The drought continued throughout the month, accompanied by bright sunshine; the little grass was burnt up, and most of

the wells believed to be constant, failed. Such a drought has not been known here before, as the finest weather usually breaks in July. Hot easterly winds prevailed at the close of the month.

QUINISH, MULL.—A hot, dry month with much sunshine. Great scarcity of water in the Hebrides generally, owing to the long-continued drought.

LOCHERROOM.—The last three months were probably the driest consecutive three that have occurred during the last half century. It is now beginning to tell most disastrously on the crops, and especially on the grazing. Some turnip fields actually have not yet sprouted, while those sown very early are looking well.

CULLODEN, INVERNESS.—A fine month, but B much needed. Turnip crop very poor.

DUNROBIN.—A very dry month; pastures in most cases very much dried up. Hay crop light and secured earlier than in any season for the last 20 years.

ROSBERRY.—A very fine month throughout, with a small B.

IRELAND.

CORK.—A very fine month, with the exception of a few overcast days and distant T on the 13th. B 1·16 in. less than the average of 24 years.

WATERFORD.—B ·57 in. below the average; mean temp. 58°·6.

ROSS.—The fine weather of June continued to the 11th of July, then some much-needed B fell in frequent light showers till the 24th, when there was a good fall of nearly three-quarters of an inch. The month closed with splendid harvest weather.

DUBLIN.—Warm and fine at the beginning and close, this month, on the whole, proved changeable, showery, and cool, with a great preponderance of N.W. winds. On the whole, the weather was favourable, from both a sanitary and an agricultural point of view. High winds on eight days, moderate gale on the 21st and 27th. Temp. reached 70° in screen on three days. The drought of June continued up to 6th of this month.

EDENFEL, OMAGH.—The drought which commenced on June 15th continued absolute until the 7th inst., lasting 22 days, thus covering a longer period than has been before recorded in the 25 years during which observations have been taken here. The remainder of the month was generally fresh and cool, with occasional heavy B, proving of the utmost benefit to grass and green crops, and not sufficiently persistent to impede the hay harvest. A slight frost occurred on the 7th, blackening the potato tops in low and damp situations.

EXCEPTIONAL RAINFALL, JULY 13TH, 1889.

To the Editor of the Meteorological Magazine.

SIR,—Before a carefully-observed torrential rainfall here passes into oblivion—as did a similar one 17 years ago, which I did not know then was so extraordinary—please note that on Saturday last, July 13th, between 4.35 and 5.40 p.m., 3·65 inches of rain fell here during a thunderstorm. I carefully measured and weighed it as a check at the time. The rainfall day gave 3·83 inches. I see that 3·65 in. in 65 minutes just makes your curve of extremes in *British Rainfall*, 1887, p. 134, complete.—Yours truly,

T. H. G. NEWTON.

Barrells, Henley-in-Arden, 17th July, 1889.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXIV.] SEPTEMBER, 1889. [PRICE FOURPENCE,
or 5s. per ann. post free.

ANOTHER EXTRAORDINARY RAIN IN ESSEX.

Up to the present year, among all the thousands of rain records which have passed through our hands, one fact has remained. No very exceptional fall, such as, in ordinary localities, 4 inches in one day, has ever occurred twice at any one station. But the following letters prove that the rule is broken, though evidently the writers do not fully realise the exceptional nature of what they have recorded. The facts are so unprecedented that we must put them before our readers in the very clearest way—especially noteworthy are they, as occurring at two stations where the average annual rainfall is under 24 inches—almost the driest part of the British Isles.

1888, AUGUST 1st.		1889, SEPTEMBER 2ND.
Romford, North Ockendon	4.56 besides what ran over.	4.55
„ Upminster Hall	4.50 „ „ „	4.32

We commend these figures to the consideration of those who (because they have themselves never measured two inches for one day) insist that a gauge which will hold two or three inches is large enough; it is not.

The damage by lightning was nearly as exceptional as the rain, but our readers will remember that all thunderstorm data go to the Royal Meteorological Society.

To the Editor of the Meteorological Magazine.

SIR,—The storm of August 1, 1888, with rainfall exceeding 4.56 inches, was almost repeated last night. The lightning was most vivid, varying from large sheets to zigzag serpents falling perpendicularly to the earth, at intervals almost continuously.

The thunder was terrific. The rainfall was scarcely more than a few drops till 9 p.m., when a downpour of varying volume began, so that by 11.15 p.m. 1.55 inches had fallen, which was increased to 4.55 inches by 5.15 this morning, at which time rain and thunder ceased. The storm came from S.E. and appeared to circle round this neighbourhood. The only damage at present reported here is a hay-

stack and a barn struck and burnt at 11 o'clock last night.—Yours faithfully,

ROBERT T. CRAWLEY.

North Ockendon Rectory, Romford, 3rd September, 1889.

SIR,— It may interest you to know that the rainfall in the series of storms lasting from 9 p.m. 2nd until 5 a.m. 3rd was 4.32 in. The lightning was as bad as the storm last year, but the rain not so continuous. Brentwood seems to have caught it, but there was no water out in the Romford district. The damage to cattle is great. The minimum temperature was 59° Far. I think that a great deal of rain splashed out, as the drops were very large.—Yours faithfully,
G. P. HOPE.

Upminster Hall, Essex, 3rd September, 1883.

TWO SHROPSHIRE WHIRLWINDS, AUGUST 21st.

We have been favoured with several cuttings relative to whirlwinds in North Shropshire on August 21st, and as one of them passed over property belonging to one of our correspondents, we have, in addition to the newspaper statements, the agent's report as to the damage.

We have headed this article "Two whirlwinds," but, as will presently appear, it is possible that it was two manifestations of one. Both occurred in the Northern half of Shropshire. The earliest observation of the first was at Pentre in Lat. 52° 44' N., and Lon. 2° 56' W., and it was last seen in 52° 47' N., and 2° 53' W., having travelled about 3½ miles from S.W. to N.E.—its precise mean direction was N. 32 E.

The following reports are from the *Oswestry and Border Counties Advertiser*.

"Our Nescliff correspondent writes.—On Wednesday about 1.45 p.m., the inhabitants of this neighbourhood were alarmed by the extraordinary roaring noise accompanying a very dark and heavy cloud which was approaching from the direction of Melverley. It passed over the Pentre, doing comparatively little damage beyond scattering the fields with boughs of trees. It next passed over Mr. John Green's at Wilcot, making the sheds and barns rattle, then down one of that gentlemen's wheat fields, laying low all the mows in the line of direction, which was about 70 yards wide, through a small coppice, lopping the top off most of the trees, and then made for Hopton, leaving the "Old Three Pigeons" on its right, and the Prill on its left. The first place to show signs that something very unusual was happening was Mr. Wilding's buildings, where the ridge tiles were all blown off, also the slates for nearly a yard on each side of the building. In a field to the left stood an ash tree, whose slender top, measuring about four yards in length, was snapped

off and carried over the top of Hopton Hill. At the Quarry House 10 plum trees were uprooted, and an apple tree was blown on to the roof of the next house, Mr. Bowker's, making a great hole therein. Every garden in Hopton, between Nescliff Hill and Mrs. Suckley's, was strewn all over with fallen apple trees, plum trees, walnut trees, and the branches of elm, oak and ash trees, carried from trees in the hedges and fields. The cyclone now swept up the bare face of Hopton Hill, and leaving untouched a distance of about 50 yards, descended with renewed force upon a coppice at the back of the hill, belonging to Mr. Lloyd, the Knolls, where between 100 and 150 trees, mostly larch, well-grown, and measuring from one to three feet in circumference, were torn up by the roots. The last heard of it was at Queen's Court, between Little Ness and Ruyton-xi-Towns, where more trees were blown down. Close by, Dr. Burrell and a lady in a trap were sheltering under an oak tree, when a bough came crashing down and smashed the shafts, besides doing other damage. In a most remarkable manner the occupants of the trap escaped with a fright and a shaking. A gentleman from Yorkshire, staying at Hopton, says the whole thing lasted only two or three minutes, and during that time the air was full of leaves, birds and branches, all being whirled around, and finally disappearing over Hopton Hill. The direction was from south-west to north-east."

"Another correspondent writes:—On Wednesday afternoon a cyclone passed through the neighbourhood of Hopton, near Nescliff and Valeswood, near Ruyton. It came on suddenly with a great roar, and appeared like a white vapour. At Mr. Bowker's, of Hopton, it tore the boughs of several trees and scattered some of them a distance of about 30 yards. The cyclone passed from there to Hopton Hill, where it uprooted nearly 200 trees and tore the tops off many others. In several gardens near the hill it uprooted fruit trees. The cyclone passed on over the cliff in Valeswood, and again tore the tops off trees. Dr. Burrell and Mrs. Pollard of Ruyton-xi-Towns were passing by Valeswood in a trap at the time, when a bough of a tree fell upon them, breaking the trap and slightly injuring Mrs. Pollard, the doctor escaping unhurt. The cyclone passed on to the New Mills, Ruyton, where it expended itself. It there carried a sheep trough about seven yards, and carried a door mat into the air a distance of about 30 feet."

The second whirlwind is first reported from a farm known as Waterloo, in Lat. $52^{\circ}53'$ N. and Lon. $2^{\circ}45'$ W., or about 9 miles N 37° E. of where the previous one disappeared, and is said to have expended itself at Tilstock Park in Lat. $52^{\circ}56'$ N. and Lon. $2^{\circ}42'$ W., after a path of $3\frac{1}{4}$ miles with a mean direction of N. 37° E. It will be noticed that *débris* is said to have been carried over Whitchurch, which is 6 miles N. 31° E. of Waterloo.

"On Wednesday afternoon the neighbourhood of Whixall was visited by a great whirlwind, and very considerable damage has been

done to property and crops. The inhabitants agree in the description they give of the phenomenon. Without any warning, the cyclone came on with a great roar, which for the time drowned all ordinary sounds, as if it were the rush of a large body of water ; and an intense feeling of terror was created. This sound lasted about five minutes, and in that short space of time trees were uprooted and stripped of their branches, haystacks were bodily displaced, houses were partially unroofed, and barns and outbuildings were demolished. The cyclone appears to have originated at Mr. Sherwood's, of Waterloo, where many plum and other trees were uprooted. It then went over the canal, past Bostock Hall, and on to Whixall Hall, which suffered most. There Mr. William Sutton, of Rose Cottage, Whixall, brother-in-law to Mr. Darlington, the occupier of the hall, had a very narrow escape. He states that he was blown across a large yard just outside the hall, and a heavy stone crest, which was torn off the upper part of the hall, with some tiles, struck him on the side of the head. He was just able to avoid it falling directly upon his head by a sudden movement, and he escaped with a deep cut over his ear. He is now confined to his room and under medical treatment. Part of his property also suffered. Mr. Darlington and his family saw from within, great branches of trees torn off and carried away. Some part of a large beech tree was carried 150 yards, crashing up against the strong walls of the hall. A big dog kennel and dog went away in the wind a distance of some twenty yards. Orchards, gardens, cornfields, and the land around the hall were strewn all over with branches, hay, straw, slates, and various missiles ; and Mr. Darlington is at present unable to estimate his loss, which must be very considerable. A large farmstead, half a mile from Whixall Hall, and occupied by Mr. Fowles, was also greatly damaged, and it was there evident that the cyclone had a peculiar deviation in its course, for a range of outbuildings which might have been thought to be in the greatest danger remain as before, while structures on the opposite side were swept away. Uprooted trees and branches and *débris* indicate clearly that the cyclone passed directly over several country residences, whose occupants were in indescribable dread of being carried away. The cyclone took a westerly course—[No ; from S.W.—*Ed. M.M.*]—about three and a half miles in length and 150 yards in width, expending itself at Tilstock Park, four miles from Whitchurch. It first appeared like a great white mass of vapour. An idea may be conceived of its tremendous force from the fact, which is stated by eyewitnesses, that portions of trees and quantities of hay and straw were carried over the outskirts of Whitchurch. Large numbers of people from various parts visited the district on Friday. A Canadian gentleman who happened to be on a visit to the district and who has witnessed cyclones in America, declares that this is of a precisely similar description, though inferior in extent and velocity."

The letter from Mr. Tayleur's agent is chiefly confirmatory, but we quote two sentences.

"The tenant's [of Whixall Hall] wife and daughter, heard a rushing sound and saw a white silvery mist approaching the house."

"It blew all the haystacks over, carried a dog and its kennel many yards, removed a big horse trough no one knows where, carried corn away by its roots, and tore many trees down. It seems to have devastated about 50 yards wide."

SUMMARY.

If we join Pentre and Whitchurch by a straight line it will be 18 miles long, and have a direction of N.37°E.; the first track occupies the first $3\frac{1}{2}$ miles of this line, and no damage is reported a quarter of a mile laterally from the straight line. There are then nine miles without a record, followed by the second track, which makes a slight eastward bend, but is never $\frac{3}{4}$ of a mile from the straight line, and which returns actually on to it. The path in the earlier part is said to have been about 70 yards wide, and in the latter part, by the reporter, 150 yards wide, by Mr. Mainwaring 50 yards.

All these points of agreement lead us to infer that it was two manifestations of one phenomenon.

BATCOMBE WATERSPOUT.

To the Editor of the Meteorological Magazine.

SIR—The other day I met a lady who knows Batcombe well, and she said that she distinctly remembered having seen, a few years ago, a large waterspout carried up from the sea, with one of its spouts dangling over Batcombe Hill. On that occasion it did not burst, but was eventually drawn up into the clouds.—Yours truly,

H. J. POOLE.

Stowell Rectory, Sherborne, 22nd Aug., 1888.

SIR,—I think you mistake the object of my letter, which was not to deny the power of the wind, whatever form its force may assume, whether direct or in whirls, but to show, according to my ideas, that the waterspout could be as easily accounted for by ordinary natural causes, as that it "was sea water lifted from the English Channel by a whirlwind." It was reading the most interesting report of this waterspout (pp. 84-5), that led me to calculate the actual quantity of water contained in such heavy clouds; and I must acknowledge that the amount was a surprise to me. If there be 10 grains in a foot of saturated air, we may very well suppose that a foot of heavy thunder-cloud would contain a very much larger quantity, and this again increased many, many fold by electrical attraction and consequent concentration prior to discharge.

I have lived long enough to know the danger of denouncing, prior to proof, any hypothesis, however absurd it may at first sight appear, *e.g.*, I would not deny M. Fayer's ideas, little as I believe in them, of his colliding aerial cones being the cause of tornadoes, but I prefer the simpler one of electrical discharges, or currents. So in this case. When we take into consideration the enormous mass of water required to dig holes 8 feet deep in High Stoy, and to do all the damage reported from Batcombe and there away, it is all the better to account for its advent from the clouds, rather than from the English Channel.

From what I have seen, read, or heard of thunderstorms, tornadoes, whirlwinds, *et hoc genus omne*, they all appear to me to arise from one great cause, viz., the existence of two vast accumulations of electricity of opposite kinds: one in the earth, the other in the atmosphere. One of these being induced by the other; and that the current arising from the interchange, or mixing of these accumulations, under various atmospheric and mundane conditions, is the cause of the variety of forms assumed by these different phenomena. The first cause of these accumulations is and has ever been a puzzle to the best electricians, but much is being done to clear up the difficulty, *e.g.*, the interesting observations and experiments made on Teneriffe by the Hon. Ralph Abercromby, together with those at Greenwich, Kew, and elsewhere. You are wrong in using the word "only" with respect to what I said in my last letter, for I think all your examples of whirlwinds, and their atrocities, are explicable by the theory of electric currents, which as surely exist, in the ordinary course of nature, as do those of water or wind.

ROBT. J. LECKY.

August 23rd.

SALT HAILSTONES.

To the Editor of the Meteorological Magazine.

SIR,—Mr. Webb gives in your last issue a circumstantial and interesting account of salt hailstones having falling on the 7th of last June at Mr. Rogers' farm near Tunbridge, and his suggestion of their being caused by salt water, "drawn up into the clouds by a waterspout," was so much in accord with the idea of the whirl of salt water on High Stoy, that I asked a gentleman at Tunbridge Wells if he could ascertain the facts of such an extraordinary occurrence. He luckily is acquainted with Mr. Rogers and writes me that "Mr. Rogers seemed greatly surprised and amused at his remark as to the saltish taste of the hailstones having been taken seriously. He says that on coming home he told his people that he fancied it had a saltish taste, but he is by no means sure that it really was salt; he only just fancied it." He thinks that there must have been some exaggeration arising out of his ladies' correspondence with Bristol.

My friend also states that the hailstones which fell at his place, near to Tunbridge Wells, were the largest he had ever seen, some being a little over one inch in diameter and a little under half an inch in thickness ; he did not see any resembling walnuts. He goes on to say that he brought a number of the largest into the house, and the thermometer being 80° and the air very sultry, he found a few of them very refreshing, and that he certainly did not perceive any saline taste. Some of his friends also give him exactly the same experiences.

I fear, therefore, that this interesting story must go in the same category as the Pembroke Dock snail shells, and that it certainly wants, both mentally and physically, "a good pinch of salt."

ROBT. J. LECKY.

August 31st, 1889.

[Being desirous of economizing time and space, we sent a proof of the above to Mr. Webb and have received the following reply, with which we think that the discussion should close.—ED. M. M.]

To the Editor of the Meteorological Magazine.

SIR,—In reply to Mr. Lecky, I beg to state that Miss Rogers in her letter describing the damage done by the hailstones during the storm, says, "Father was at Haysden, he had Ben (the dog) with him ; when it saw the hail jumping about it began eating it, so Father thought he would taste it, and he said it was *very salt*."

The italics are mine. Mr. Rogers is too conscientious a gentleman to exaggerate in the least degree ; I believe his statement "very salt" is correct. It appears to me that the visitor sent by Mr. Lecky endeavoured to make some impression upon the mind of Mr. Rogers, with the object of leading him to think that his sense of taste had deceived him.

The visit of Mr. Lecky's friend reminds me of an historical fact. Galileo discovered the satellites of the planet Jupiter. But Galileo had visitors who endeavoured to persuade him to believe that his sense of eyesight deceived him. Nevertheless, they could not blot out Galileo's moons from the skies.

With regard to the form and size of the hailstones mentioned in my letter I obtained the information from the *Standard*, which gave an account of them, as seen by observers who resided in the districts over which the storm passed.

J. WEBB.

September 9th, 1889.

ERRATA IN METEOROLOGICAL MAGAZINE, 1888.

REGULAR TABLE.

Leicester, February	should be 1'39	Jedburgh, March	should be 1'98
---------------------	----------------	-----------------	----------------

SUPPLEMENTARY TABLE.

Birchington, June ...	should be 1'75	Ardwell Ho., Nov.	should be 3'76
Lancaster, February	" 1'38	Galway, July	" 4'14
Llanfrechfa, April ...	" 1'63		

THE OAK AND THE ASH.

To the Editor of the Meteorological Magazine.

SIR,—I was much interested in the article on the "Oak and Ash" in this month's *Met. Mag.* I have studied the subject myself for some years, and have long ago abandoned the idea of any truth in the theory; at the same time there are coincidences which certainly go some way for giving it a foundation.

My idea is that the Oak is much more influenced by the seasons than the Ash. The former in an early spring opens its leaves early; the latter has little variation in its time of leafing. Now, some of our wettest summers (*e.g.*, 1860, 1879, and 1888) have been preceded by cold, late springs. Hence the Oak has been late and has leafed sufficiently near the Ash that in isolated cases no doubt the Ash leaves have appeared first.

On the other hand, some of our hottest summers (*e.g.*, 1846, 1859, 1868, and 1884) have been preceded by warm, early springs, bringing the Oak into leaf exceptionally early, leaving the Ash to leaf at its usual time.

I have only noted dates of the leafing of trees for the past 9 years, but that is sufficient to bear out my statement. I have noted the date of "first leaf" of each tree, and afterwards the date of "full leaf," *i.e.*, when trees of each class are in their full foliage without exception. If we take a mean between these two dates we find the trees at a stage which would commonly be called "leafing," and the dates at foot are such intermediate dates.

Phenomena.	1881	1882	1883	1884	1885	1886	1887	1888	1889	Mean of 9 years.
Leafing of oak {	May 13	April 20	May 12	May 2	May 14	May 14	May 29	May 27	May 17	May 13
Leafing of ash {	May 19	May 11	May 17	May 17	May 16	May 21	May 31	May 26	May 25	May 20
Days oak leafed before ash ...	6	21	5	15	2	7	2	...	8	7
Days ash leafed before oak ...	...	...	..	...	...	...	...	1	...	...

The two earliest springs of the period were 1882 and 1884. Had the former been followed by a dry summer, it would have gone far in support of the theory that the oak leafing before the ash foretells a dry summer. This single instance upsets it, but confirms my view that the whole depends upon the character of the spring, early springs being more usually followed by warm summers, and late ones by wet summers.—Yours faithfully,

ARTHUR W. PRESTON.

The Rookery, Blofield, Norwich, August 20th, 1889.

To the Editor of the Meteorological Magazine.

SIR,—In all my experience of 30 or more years, I have never once seen the Ash come into leaf before the Oak. Sometimes the Oak precedes the Ash by only two or three days, but it always *does* precede, and occasionally it is 10 or 14 days in advance. This holds good in a comparison of individual specimens, or the trees in the aggregate as seen in the landscape. This year, the golden young leaves of the Oak were very conspicuous in contrast with the dark and bare aspect of the Ash, and in looking over an extensive view, this was very marked. As a prognostic, it seems to me to show the weather we have had, rather than that which is to come.

Yours truly,

FRANKLEN G. EVANS.

Llwynnarthan, Castleton, near Cardiff, August 22nd, 1889.

[The following extracts are all from *Notes and Queries*; they are the only further fresh versions that we have been able to find.—ED.]

2nd Series, x., p. 184. September 8, 1860 :—

Oak before Ash,
There'll be a splash;
Ash before Oak,
There'll be a choke.

2nd Series, Vol. x., p. 256. September 29, 1860.

When the Ash comes out before the Oak
A wet summer, and no joke;
When the Oak comes out before the Ash
A dry summer, and no splash.

4th Series, Vol. xi., p. 421. May 24, 1873.

Oak, smoke.
Ash, squash.

4th Series, Vol. xii., p. 184. September 6, 1873.

OAK AND ASH.—This old saw should be for ever disposed of by competent authority, for it is one of those "vulgar errors" by which tradition attempts to stultify observation; and I agree with Mr. Wickham that "this miracle," as he calls it, is a delusion. I have, for many years past, been careful to observe the order of the leafage of trees, and I extract the following paragraph from my *Pictures of Nature round the Malvern Hills*, published nearly twenty years ago.

"Every year, as a general fact, the oak is in leaf before the ash; yet in some localities a few flourishing ash trees may exhibit foliage before oaks not so favourably circumstanced. Thus last year (1854) I observed that in Cowleigh Park, on April 27th, the oak was generally out in leaf, and the ash not so; yet on the side of the Cradley-road, with a northern exposure, neither oak nor ash was in leaf. Yet on the eastern side of the Ridgway, in Cradley, there was an ash coming into leaf, while two young oaks beside it were quite bare."

Situation and exposure determine the foliation of forest trees, and

an observer may, any year, notice similar anomalies to those above stated. But though a few oaks in unfavourable situations may be leafless while an ash in a sunny aspect shows expanding foliage, I never saw even a single ash thus circumstanced without there being numerous oaks in leafage at the same time, and numerous ash trees altogether bare. The last three years have shown, as usual, the general precedence of the oak in showing foliation to the ash, and therefore, any idea of a wet season being predicated from any single ash tree showing premature foliage is altogether delusive. When, indeed, both trees antedate their usual leafage time, a temperature above the average of the vernal period may be inferred, but the expanded leaves of the oak would always be in the van.

EDWIN LEES, F.L.S.

Worcester.

Elias Loomis.

Died August 15th, 1889, aged 78.

America has lost in Loomis one who for nearly half a century has been among its leading meteorologists. Loomis's first paper, "On Shooting Stars," appeared in Silliman's Journal for 1835, and he has continued working and writing, down to the present year. His attention has been equally divided between astronomy, magnetism, and meteorology, and he has done good work in all three subjects. His studies of the storms of December 30th, 1836, and October 20th, 1837, were among the earliest published specimens of the modern mode of tracking storms.

Prof. Loomis held various honorary titles; he was one of the 18 Ehrenmitglieder of the Deutschen Meteorologischen Gesellschaft and one of the 18 honorary members of the Royal Meteorological Society.

TRINIDAD RAINFALL.

We hope shortly to be able to give an account of the good work which is being done in Trinidad by Mr. J. H. Hart, F.L.S., but as an instalment have much pleasure in quoting the following table, of which the importance is self-evident.

This station is near the capital, Port of Spain, in Lon. $61^{\circ} 26' W.$ and Lat. $10^{\circ} 40' N.$, and therefore in the N.W. of the Island.

It will be seen that the annual fall varies between limits similar to, but rather less than, those usual in the British Isles.

	Depth. in.		Ratio.
Maximum	86.82	.....	133
Mean	65.45	.....	100
Minimum	43.22	.....	66

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Total.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1862	·00	·66	·77	·25	1·41	8·47	10·36	9·57	11·97	6·60	10·06	3·03	63·15
1863	1·54	2·71	1·45	·85	1·26	9·12	10·12	10·53	12·11	6·24	4·30	6·57	66·80
1864	2·51	·53	·36	·04	8·15	4·96	7·17	12·06	8·04	6·53	5·94	6·61	62·90
1865	2·62	3·20	1·07	7·98	3·22	5·64	10·35	12·83	7·32	14·62	4·81	9·62	85·28
1866	2·24	3·91	1·44	1·09	1·45	6·69	7·83	12·34	5·87	10·11	8·17	6·82	67·86
1867	1·31	6·36	·83	1·32	2·33	5·30	12·20	15·21	10·45	7·87	·67	2·71	66·56
1868	2·06	·82	3·20	·64	4·17	7·78	11·35	8·73	5·46	4·66	8·31	1·03	56·21
1869	·08	·93	·74	·41	·69	5·52	10·17	6·74	8·86	5·15	6·30	5·87	53·46
1870	2·61	·56	1·46	1·51	4·65	8·81	11·91	9·00	10·63	3·98	5·94	8·29	69·35
1871	6·62	1·40	2·89	·92	3·97	8·84	11·73	12·97	7·87	4·37	10·73	3·27	75·58
1872	1·45	·07	·74	·39	3·14	7·09	5·45	10·82	3·07	4·80	9·89	3·04	49·95
1873	1·78	1·08	1·98	·53	·00	4·31	5·04	8·37	5·80	10·34	3·48	1·31	44·02
1874	3·47	1·96	3·67	5·16	2·51	12·28	12·28	11·20	9·38	6·42	3·66	4·29	76·28
1875	3·39	·91	·56	·42	2·61	4·15	12·62	7·22	11·95	10·85	3·74	2·48	60·90
1876	3·26	1·03	1·78	1·67	6·65	11·17	12·23	15·18	12·03	7·04	5·95	3·96	81·95
1877	2·14	·00	7·46	3·38	3·19	8·43	8·35	12·94	6·39	6·68	7·66	5·48	72·10
1878	3·44	·70	·00	3·22	4·99	5·78	5·42	8·88	11·15	5·89	8·72	3·05	61·24
1879	1·52	2·76	4·56	3·03	3·08	14·92	6·86	10·35	6·15	3·54	4·28	4·38	65·43
1880	11·72	6·53	·67	2·32	3·90	7·83	6·30	17·39	7·47	5·74	10·51	1·96	82·34
1881	·57	·65	·23	1·60	4·66	11·05	7·82	10·90	10·59	3·36	12·06	2·23	65·72
1882	1·33	2·38	·73	1·57	3·74	6·33	7·82	8·40	4·93	5·86	10·29	1·50	52·99
1883	1·56	·71	·26	3·37	5·89	10·91	13·66	10·96	5·53	3·99	6·06	8·30	70·50
1884	3·43	2·50	4·40	1·51	2·91	6·84	5·71	8·70	5·03	5·05	5·14	5·66	56·88
1885	1·30	·89	1·49	·43	5·27	3·44	5·87	4·56	6·08	4·08	5·37	4·44	43·22
1886	3·32	1·97	3·27	3·83	4·49	9·70	17·48	8·15	6·73	12·59	8·54	6·75	86·82
1887	2·69	1·46	1·67	1·08	3·98	7·40	5·51	9·93	5·07	5·84	7·60	11·86	64·09
1888	8·37	1·79	2·41	2·28	3·46	11·92	6·89	7·02	5·53	5·06	7·76	2·95	65·44
Means	2·83	1·80	1·85	1·88	3·55	7·95	9·13	10·45	7·83	6·57	6·89	4·72	65·45

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, FEBRUARY, 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	58·1	17	20·4	13	43·3	31·7	33·2	86	86·3	13·5	2·28	18	6·8
Malta	72·5	27	41·0	14	60·2	50·0	45·5	75	117·7	39·0	1·60	12	5·7
Cape of Good Hope. ...	90·2	25	53·8	14	79·6	60·6	...	...	...	...	1·22	3	4·3
Mauritius	84·0	4, 9	69·0	11, 13	82·9	73·1	69·6	78	136·4	61·1	5·51	15	6·2
Calcutta	87·3	28	49·6	6	80·0	59·1	57·2	60	141·8	40·4	2·46	4	1·6
Bombay	89·7	12	64·8	1	83·7	69·3	65·2	69	141·6	58·0	·00	0	0·8
Ceylon, Colombo	...	...	...	...	...	...	...	...	...	...	...	...	...
Melbourne	96·0	13	45·5	20	78·2	56·6	54·1	67	149·8	33·0	1·50	7	5·6
Adelaide	100·4	2	53·5	28	85·0	61·8	51·4	46	160·7	42·1	·23	2	4·0
Wellington	79·0	8, 27	48·0	19	70·4	56·0	53·8	72	139·0	·28	1·48	7	3·4
Auckland	80·0	18	55·0	3, 4	74·8	59·5	57·3	71	145·0	43·0	4·04	9	5·0
Jamaica, Kingston	92·2	9	62·6	8	89·1	67·1	68·1	73	...	...	0·45	...	...
Trinidad	93·0	3	61·0	13	89·1	68·2	68·2	85	157·0	57·0	·93	...	...
Toronto	39·8	17	—11·3	6	26·1	8·0	16·0	82	...	—18·6	2·37	19	6·6
New Brunswick, Fredericton	42·9	6	—33·0	24	25·3	— 0·8	10·7	76	...	...	3·55	14	4·6
Manitoba, Winnipeg ...	40·0	28	—42·6	23	7·6	—15·2	2·3	95	...	...	1·03	8	5·0
British Columbia, Victoria	57·0	27	25·0	18	46·3	35·8	...	...	...	...	1·12	7	...

REMARKS, FEBRUARY, 1889.

MALTA.—Mean temp. 54°·4; mean hourly velocity of wind 15·5 miles. Sea temp. fell from 60°·0 to 57°·0. H on 14th, 16th and 23rd. A hot wind from S.W. with haze on the 26th raised the temp. to 70°·0 at 8 p.m. J. SCOLES.

Mauritius.—Mean temp. of air 1°·0, and of dew point 0°·2 below, and R ·36 in. above, their respective averages. Mean hourly velocity of wind 10·7 miles, or 0·3 below average; extremes 27·1 on 22nd and 0·0 on 13th. Prevailing direction, E.S.E. T on 5 days, and L on 6 days. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·3, of dew point 0°·9, humidity 1, and mean amount of cloud 0·3 above average; R ·44 in. below average. Prevailing winds S. and S.W.; strong on 8 days. Greatest hourly velocity 31 miles from 3 to 4 p.m. on 27th from W. Heavy dew on 3 days. L on 4 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. slightly below, and R less than half the average. C. TODD, F.R.S.

Wellington.—Fine in the early part of the month, with light southerly winds, showery from 10th to 12th, then fine again until the 19th when ·50 in. of R fell, and the remainder of the month fine. Prevailing wind N.W., strong on 7 days. R. B. GORE.

Auckland.—Rainfall slightly in excess of the average of 22 years; mean temp. close to the average, barometric pressure slightly below. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
AUGUST, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	2.60	XI.	Castle Malgwyn	3.24
"	Margate, Birchington...	1.73	"	Rhayader, Nantgwillt..	6.32
"	Littlehampton	2.33	"	Carno, Tybrith	5.32
"	Hailsham	2.65	"	Corwen, Rhug	3.36
"	Ryde, Thornbrough	2.90	"	Port Madoc	6.72
"	Alton, Ashdell	2.30	"	I. of Man, Douglas	5.32
III.	Oxford, Magdalen Col...	2.29	XII.	Stoneykirk, Ardwell Ho.	5.10
"	Banbury, Bloxham	2.48	"	New Galloway, Glenlee	5.37
"	Northampton	1.76	"	Melrose, Abbey Gate	4.80
"	Cambridge, Beech Ho...	2.01	XIII.	N. Esk Res. [Penicuik]	7.10
"	Wisbech, Bank House..	2.04	XIV.	Ballantrae, Glendrisaig	5.01
IV.	Southend	2.33	"	Glasgow, Queen's Park..	4.35
"	Harlow, Sheering	2.42	XV.	Islay, Gruinart School..	5.47
"	Rendlesham Hall	4.22	XVI.	Dollar	5.19
"	Diss	3.26	"	St. Andrews, Pilmour Cot	5.64
"	Swaffham	4.30	"	Balquhider, Stronvar..	6.16
V.	Salisbury, Alderbury...	1.96	"	Dunkeld, Inver Braan..	5.77
"	Warminster	2.76	"	Dalnaspidal H.R.S. ...	7.81
"	Bishop's Cannings	3.51	XVII.	Keith H.R.S.	5.89
"	Ashburton, Holne Vic...	4.83	"	Forres H.R.S.	4.73
"	Hatherleigh, Winsford.	3.11	XVIII.	Strome Ferry H.R.S....	6.83
"	Lymouth, Glenthorne.	3.45	"	Fearn, Lower Pitkerrie.	4.55
"	Probus, Lamellyn	3.60	"	Loch Shiel, Glenaladale	...
"	Launceston, S. Petherwin	3.94	"	N. Uist, Loch Maddy ...	5.33
"	Wincanton, Stowell Rec.	3.38	"	Invergarry	5.35
"	Taunton, Lydeard Ho...	2.87	"	Loch Ness, Drumnadrochit	4.76
"	Wells, Westbury	4.47	XIX.	Lairg H.R.S.	5.44
VI.	Bristol, Clifton	3.33	"	Forsinard H.R.S.	...
"	Ross	2.23	"	Watten H.R.S.	3.91
"	Wem, Clive Vicarage ...	4.06	XX.	Dunmanway, Coolkelure	3.78
"	Cheadle, The Heath Ho.	3.97	"	Fermoy, Gas Works ...	5.20
"	Worcester, Diglis Lock	2.28	"	Tipperary, Henry Street	5.11
"	Coventry, Coundon	2.54	"	Limerick, Kilcornan ...	4.84
VII.	Ketton Hall [Stamford]	2.92	"	Miltown Malbay	6.08
"	Grantham, Stainby	3.52	XXI.	Gorey, Courtown House	3.85
"	Horncastle, Bucknall ...	3.55	"	Navan, Balrath	5.49
"	Mansfield, St. John's St.	2.08	"	Mullingar, Belvedere ...	5.78
VIII.	Neston, Hinderton	4.46	"	Athlone, Twyford	5.26
"	Knutsford, Heathside ...	5.64	"	Longford, Currygrane...	5.11
"	Lancaster, South Road.	5.42	XXII.	Galway, Queen's Coll...	4.80
"	Broughton-in-Furness ..	7.18	"	Clifden, Kylemore	9.83
IX.	Wakefield Prison	3.58	"	Crossmolina, Ennisacoe.	7.02
"	Ripon, Mickley	4.11	"	Collooney, Markree Obs.	5.96
"	Scarborough, West Bank	4.53	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	4.17	XXIII.	Warrenpoint	6.93
"	Middleton, Mickleton..	3.59	"	Seaford	5.55
X.	Haltwhistle, Unthank..	5.19	"	Belfast, New Barnsley..	7.98
"	Shap, Copy Hill	4.73	"	Bushmills, Dundarave...	6.15
XI.	Llanfrechfa Grange	3.88	"	Stewartstown	7.27
"	Llandovery	4.19	"	Bunorana	6.44

AUGUST, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which "01 or more fell.	TEMPERATURE				No. of Night below 32°
		Total Fall.	Differ- ence from average. 1870-9	Greatest Fall in 24 hours.		Max.		Min.				
				Inches.	In.			Deg.	Date.	Deg.	Date.	
I.	London (Camden Square) ...	1.80	— .94	.31	19	16	84.4	1	44.2	25	0 0	
II.	Maidstone (Hunton Court)...	1.77	— .47	.46	19	13	...	...	...	...	0 0	
III.	Strathfield Turgiss	2.47	+ .05	.77	21	17	80.9	30	39.7	25	0 0	
III.	Hitchin	1.21	— 1.07	.37	21	14	77.0	1	45.0	24	0 0	
IV.	Winslow (Addington)	2.31	— .64	.47	9	14	83.0	1	40.0	25	0 0	
IV.	Bury St. Edmunds (Westley)	3.33	+ 1.21	.87	11	14	...	...	...	...	...	
V.	Norwich (Cossey)	3.15	+ .53	.86	11	21	...	...	...	...	...	
V.	Weymouth (Langton Herring)	2.20	— .48	1.0	16	16	73.0	31	47.0	25b	0 0	
"	Barnstaple	2.89	— 1.21	.45	23	20	77.0	1a	43.0	21	0 0	
"	Bodmin	...	...	...	...	...	...	...	...	...	...	
VI.	Stroud (Upfield)	2.04	— 1.13	.48	21	17	80.0	1, 2	42.0	24	0 0	
"	Church Stretton (Woolstaston)	3.19	— .89	.59	21	22	76.5	30	45.0	23c	0 0	
"	Tenbury (Orleton)	2.61	— 1.11	.46	10	15	80.2	30	35.0	25	0 1	
VII.	Leicester (Barkby)	2.79	+ .24	.54	9	18	85.0	1	39.0	24	0 0	
"	Boston	3.42	+ .81	.95	11	18	87.0	30	44.0	26	0 0	
"	Hesley Hall [Tickhill]	2.76	— .48	9	18	78.0	1, 30	42.0	25	0 0		
VIII.	Manchester (Plymouth Grove)	6.00	+ 2.14	.76	5	22	76.0	30	43.0	24	0 0	
IX.	Wetherby (Ribston Hall) ...	4.96	+ 2.33	.51	15	21	...	...	...	...	...	
"	Skipton (Arncliffe)	7.21	+ 1.41	.74	5	26	78.0	1	38.0	24c	0 0	
"	Hull (People's Park)	4.03	+ 1.01	.98	11	21	...	...	...	...	...	
X.	North Shields	4.54	+ 1.45	1.00	19	21	75.0	1	43.0	25	0 0	
"	Borrowdale (Seathwaite)	11.92	+ .88	1.42	5	26	...	...	...	...	...	
XI.	Cardiff (Ely)	4.68	— .65	.97	2	20	...	...	...	...	...	
"	Haverfordwest	4.61	— .36	.67	19	20	71.0	2, 30	41.4	10	0 0	
"	Plinlimmon (Cwmsymlog) ...	...	...	...	...	...	...	...	...	...	...	
"	Llandudno	3.85	+ .66	.97	19	17	70.0	1	47.0	11	0 0	
XII.	Cargen [Dumfries]	4.46	+ .19	.76	19	24	70.2	1	40.0	31	0 0	
"	Jedburgh (Sunnyside)	4.54	+ 1.17	1.05	19	21	71.0	1	40.0	31	0 0	
XIV.	Old Cumnock	5.64	+ 1.50	1.14	5	24	76.5	1	33.0	25	0 0	
XV.	Lochgilhead (Kilmory)	5.82	+ .60	1.53	19	21	...	...	...	...	...	
"	Oban (Craigvarren)	6.16	—	1.20	27	24	67.0	1	44.8	24	0 0	
"	Mull (Quinish)	6.30	—	1.55	27	24	...	...	...	...	...	
XVI.	Loch Leven Sluices	5.60	+ 1.52	1.00	17	16	...	...	...	...	...	
"	Dundee (Eastern Necropolis)	6.50	+ 3.23	1.00	9	20	76.3	1	42.1	24d	0 0	
XVII.	Braemar	7.57	+ 3.14	2.13	9	27	69.7	1	35.2	31	0 0	
"	Aberdeen (Cranford) ...	5.64	—	1.45	10	22	73.0	1, 2	42.0	23e	0 0	
XVIII.	Lochbroom	3.96	—	.55	21	21	...	...	...	...	...	
"	Culloden	4.83	+ 1.83	...	...	...	75.0	1	43.0	14	0 0	
XIX.	Dunrobin	...	...	...	...	...	...	...	...	...	...	
"	S. Ronaldsay (Roseberry)	5.99	+ 3.29	1.94	20	23	66.0	2	43.0	26	0 0	
XX.	Cork (Blackrock)	4.85	+ 1.02	1.36	19	17	77.0	25	43.0	24f	0 0	
"	Dromore Castle	3.63	—	1.55	19	22	72.0	3	45.0	31	0 0	
"	Waterford (Brook Lodge) ...	4.78	—	1.23	19	18	70.0	30	43.0	26	0 0	
"	O'Briensbridge (Ross)	5.75	—	2.48	19	23	74.0	1	40.0	25g	0 0	
XXI.	Carlow (Browne's Hill)	5.13	+ 1.40	1.45	19	21	...	...	...	...	...	
"	Dublin (Fitz William Square)	5.75	+ 2.57	1.94	19	22	71.8	1	46.4	25	0 0	
XXII.	Ballinasloe	4.21	+ .18	1.30	19	23	66.0	1h	41.0	25	0 0	
XXIII.	Waringstown	7.29	+ 3.85	1.61	19	24	72.0	1	41.0	31	0 0	
"	Londonderry (Creggan Res.) ..	7.95	—	1.27	9	30	...	...	...	...	...	
"	Omagh (Edenfel)	5.69	+ 2.04	.99	19	25	68.0	1	42.0	20	0 0	

α And 2, 31. b And 27. c And 25. d And 26. e And 30. f And 31. g And 26, 27. h And 2, 16
 + Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON AUGUST, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—On the whole, August was rainy and chilly, and at times stormy. The close of the month was beautifully warm and clear, a second summer, very acceptable to the farmers. TS on 24th. T on three other days.

HITCHIN.—Extraordinary high average temp. May, $56^{\circ}0$; June, $60^{\circ}9$; July, $61^{\circ}0$; August, $61^{\circ}5$. Only exceeded once in 40 years, viz., in 1868, when the values were $55^{\circ}5$, $60^{\circ}5$, $64^{\circ}8$, $61^{\circ}9$.

ADDINGTON.—The 1st was very fine, with high temp., and the 2nd was also fine, but from thence until the 25th was very unfavourable, R falling so frequently as to hinder harvest work very much. From the 25th until the end, the weather was all that could be desired. TS on 24th with heavy R.

BURY ST. EDMUND'S, WESTLEY.*—A very similar month to August, 1881, when the harvest was one of the worst in the century. This year we had more wind, so the corn was not so much sprouted, but the barley was much discoloured. TSS on 11th and 24th.

1889	Rainfall.	Diff. from Average.	1889	Rainfall.	Diff. from Average.
Jan.....	·69	 - 1·07	May.....	3·99	 + 2·02
Feb.....	1·46	 - ·25	June.....	3·06	 + ·92
Mar.....	1·05	 - ·41	July.....	3·18	 + 1·21
April.....	2·11	 + ·37			

LANGTON HERRING.—The weather from the 1st to the 24th was very variable and unsettled; the last week was bright and fine for carrying the harvest. R ·18 in. below the average. Mean 9 a.m. temp. $1^{\circ}1$ below the average. A fine parhelion was observed on 13th. On the 29th the moon before setting appeared of a crimson colour.

WOOLSTASTON.—A cold and stormy month till the last five days, when the weather became very hot. Sharp storms of T and L on 9th and 11th. Mean temp. $57^{\circ}4$.

ORLETON.—The temp. was above the average on the first 8 days, which were warm and pleasant, the weather then became cold and changeable, with frequent falls of R, much cloud, and very variable winds; it continued generally cold till the 28th, when the temp. rose and the last 3 days were very bright and warm. Mean temp. about $1^{\circ}3$ below the average of 28 years. Distant T on the 5th, 8th, 9th, and 10th. Strong wind on 20th. Slight frost on the morning of the 25th, and thick fog on the 30th. Harvest retarded.

BARKBY.—There were frequent TSS, and T was heard on 7 days. Mean temp. $58^{\circ}3$. Three-fourths of the corn harvest was secured by the end of the month.

MANCHESTER, PLYMOUTH GROVE.—The wettest August in 23 years. The mean temp. $58^{\circ}5$.

HULL.—With the exception of the last few days, the weather during the month was generally overcast or very cloudy, with frequent falls of R, and T on several occasions.

* The observations at Culford having ceased, the station is replaced by Westley, and we give the rainfall for the earlier months of the year.

WALES.

HAVERFORDWEST.—A month of constant **E** up the 24th, with temp. below the average. No heavy falls of **R** took place, consequently the river Cleddau was never once in flood, nor were the corn crops beaten down or injured by the damp. The temp. reached 70° on four days, three times in the first week and once in the last. Fine bright sunshine prevailed during the last 7 days, with, during the last three days, increase of temp. ; all the cereals are good, early turnips a good crop. Winds principally from westerly points.

SCOTLAND.

CARGEN.—A very unfavourable month for harvest operations. Duration of sunshine 61 hours below the average. Mean temp. 1°·7 below the average. The winds were generally very light throughout, and the atmosphere was laden with moisture. **T** on 6th, 7th, and 11th. It is feared the grain has suffered materially in quality, as a large breadth was cut before the middle of the month and little or none secured.

JEDBURGH.—**E** was frequent, but the cutting of the cereals went on steadily. The root crops are singularly good and promising.

LOCHBROOM.—The copious **R** of the month was very much required after the heat and drought of the last three months, and on the whole it was a beautiful month.

INVERNESS, CULLODEN.—Heavy rains occurred on the 8th, 9th, 21st, 22nd, and 23rd, and where the crops are heavy, considerable damage must result.

ROEBERRY.—The wettest August since 1879.

IRELAND.

CORK.—Showery and chilly up to the 25th, which much retarded harvest operations, thence to the close very fine, and the farmers were freed from serious apprehensions. **T** and **L** on 9th, distant **T** on 21st. Gale on 19th.

WATERFORD.—Rainfall 1·04 in. above the average. Mean temp. 57°·7. **T** on 6th, 9th, and 11th. **R** on 6th and 11th.

ROSS.—A bad month for hay harvesting. **T** on 14th, 15th, and 16th. The **R** on the 19th (2·48 in.) was continuous for 20 hours, and the heaviest within 24 hours from 1846 to the present time.

DUBLIN.—A wet, cold, and stormy month. Mean temp. 1°·2 below the average. Strong or squally winds on 14 days. Gales on 6th and 20th. Foggy on 31st. **T** heard on 7th and 11th. **L** seen on 30th. Temp. reached 70° in screen on only two days. A marked improvement took place in the weather from 25th to 31st inclusive. Prevailing winds westerly. Mean humidity 84; mean amount of cloud 6·0.

WARINGSTOWN.—The largest monthly **R** recorded since observations commenced in 1860, the next greatest fall being 6·81 in. in October, 1870. Total fall from July 15th, in St. Swithin's 40 days, 8·19 in. No serious injury to crops up to the close of the month.

EDENFEL, OMAGH.—A persistently wet and unsettled month without one summer's day, owing, however, to the previous favourable weather and to the fact that the harvest is seldom general before September; the fine weather that has now set in is enabling abundant crops to be gathered in excellent condition.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXV.] OCTOBER, 1889.

- [PRICE FOURPENCE,
or 5s. per ann. post free.

THE AUTUMN CONGRESSES.

Is it permissible to the Editor of a scientific journal to suggest that there is too much activity in the branch of science which he is trying to advance? The answer is not easy; progress is what one ought to aim at, activity usually implies progress, and certainly there can be little progress without activity. On the other hand, the strain may be too great. The meetings of the great scientific societies run on from October to June, and the autumns used to be quiet and restful, but first the British Association, then the Social Science, and then the Sanitary Institute, started autumn meetings, and this year our French friends have brought matters to a crisis with 68 successive and partly simultaneous congresses. Of course with very few of these had meteorologists anything to do, but the following are all meetings which come within the province of this magazine:—

The British Association, Newcastle-on-Tyne, Sept. 11 to 18.

International Congress on Meteorology, Paris, Sept. 19 to 26.

The Sanitary Institute, Meteorological Section, Worcester,
Sept. 24 to 28.

International Congress on Climatology, Paris, Oct. 2 to 10.

Obviously we cannot report fully upon all these meetings. With the exception of the British Association, full accounts of each will be published, and therefore we need give only brief notices of the others.

THE BRITISH ASSOCIATION AT NEWCASTLE-ON-TYNE.

This meeting was in point of numbers far below that held in the same city in 1863, but we see no signs of analogous depreciation in the quality of the papers read, though there was perhaps nothing exceptionally striking in them. As Prof. Cleveland Abbe favoured us with a copy of his paper, and we are not aware that it will appear elsewhere in full, we print it *in extenso*, and add abstracts of such of the other papers as we have been able to obtain.

THE DETERMINATION OF THE AMOUNT OF RAINFALL.

BY PROF. CLEVELAND ABBE.

THE accurate measure of rain is a matter of equal importance to meteorology and engineering, but like all other problems in physics the accurate determination of any datum must be accompanied by a determination of the reliability of, or the confidence to be placed in, the numerical results. There must be some estimate or determination of the "possible error" or the "probable error" of the result of our measures, before we can safely make use of that result for any further deductions.

Many investigations have been made into the reliability of rainfall measures by means of comparative observations with gauges of various patterns placed in diverse localities with regard to surrounding obstacles and at different heights in respect to the surface of the ground or at different altitudes with respect to the surface of the sea.

The general result of these investigations so far as rain proper is concerned is about as follows :—

1. *As concerns the size and shape of the collecting funnel*, circular and square apertures of from ten to one hundred square inches area give results that vary only one or two per cent. among themselves.

2. *As regards the external shape of the gauge as a whole*.—Simple cylinders or cylinders with small rims or bulging rings, or conical flanges, vary but two or three per cent. among themselves on account of shape, but all catch decidedly less than cylinders with broad flanges or shields near their apertures as in the Henry and the Nipher gauge. The excess of the catch in these shielded gauges increases slightly in proportion to the force of the wind.

3. *As regards the location*.—Gauges on the ground close to the windward side of an obstacle catch more than those in the open field ; gauges close to the leeward side catch less, while gauges a little farther to the leeward catch decidedly more ; gauges on the top of the obstacle, such as the flat roof of a house, catch less when they are near the windward side, but the same or little more than the normal when they are nearer the leeward side of the roof. This shows that the presence of an obstacle in conjunction with the wind alters the distribution of what would otherwise be a uniform rainfall ; the alteration increases more rapidly than the increase of the wind, and is approximately as the square of the velocity.

4. *With regard to elevation above sea level*.—Whether on an isolated mountain or on a broad rising plateau, on the windward side the rainfall increases up to a certain elevation and then diminishes rapidly, but on the leeward side there is only a rapid diminution from the summit downwards. In some cases this latter diminution causes an entire absence of rain over the greater part of the leeward side of the plateau or mountain ; in many cases the available mountains are scarcely high enough to enable us to observe the diminution of rain above the belt of maximum precipitation.

5. *With regard to the altitude above ground.*—The higher gauges invariably catch less rain and the discrepancies caused by altitude are so large as to have hitherto been considered as the principal source of uncertainty in rainfall measurements, so that for gauges of uniform patterns exposed in unobjectionable locations in open fields the only method hitherto prescribed for securing comparable results has consisted in the adoption of a uniform small elevation above ground ; but this rule, of course, gives us no assurance that our rainfall measurements are correct in any absolute sense. The general explanation of the fact that the higher gauges catch less rain, as given by Bache and Jevons, was that the wind causes eddies about the mouth of the gauge and carries past some of the raindrops. This explanation is undoubtedly true and suffices to explain many observed phenomena ; but if true, it should be followed out to its logical consequences and be made to give us some method of correcting the record of a gauge for the influence of the wind so as to obtain a nearer approximation to the rain that has actually fallen upon the ground ; this I will now attempt to do.

6. In the case of ordinary rainfalls the air is full of large and small drops intermixed, or of heavy and light flakes of snow ; near the ground are additional fragments of drops broken up by spattering and again during snow storms with high winds the air is full of flakes that have been whirled up into the air after having once fallen to their resting place on the ground or trees. I shall for the present omit the consideration of spattering and drifting, hoping to treat of them at some future time, and will consider only the effect of the wind on the drops falling directly into a gauge whose mouth is high enough above the ground to avoid these two influences ; in fact, spattering and drifting can only influence the local distribution of rain or snow, a gauge placed within their influence must have its readings thereby increased, and the true amount of precipitation is more easily obtained by the method I shall present, if the gauges are raised a few feet above the ground.

We therefore consider that there is falling into the gauge a quantity of drops or flakes of various sizes and various vertical velocities while the wind is blowing horizontally against the gauge.

7. Now, when the wind strikes the gauge the deflected current just above the mouth of the gauge acquires a vertical component that it did not have before it struck the gauge, and also has a horizontal motion more rapid than it had before, and more rapid than that of the wind a few inches higher up. The larger drops of the falling rain may descend with a rapidity sufficient to penetrate this swiftly moving layer and enter the gauge, but the smaller drops falling more slowly will be carried over to the leeward of the gauge, and failing to enter it will miss of being measured as rainfall, although they really go on and fall to the ground near by. Evidently of two masses of rain having the same proportion of large and small drops, or rapid and slow falling snow flakes, the proportion of small drops

that are carried by will be large in proportion as the wind is stronger, the deficiency in the catch of the gauge being very nearly proportional to the velocity of the wind. Again for the same gauges and the same velocity of wind the deficiency will be proportional to the relative percentage of small and slow falling drops that occur in any given shower. Thus we easily see that the deficiency will be greater in winter snows than in summer rains, greater in fine drizzling rains than in heavy downfalls, greater in windy localities, greater for elevated gauges than for low ones. The application of these ideas gives us a satisfactory general explanation of the numerous irregularities that have been observed in rainfalls. In fact, they explain every one of the most extreme cases, such, *e.g.*, as that recorded by the Signal Service observer at Kitty Hawk on the sandy beach of North Carolina, where nine experimental gauges were by request established in a cluster, fully exposed to the wind, with their mouths two or three feet above the surface of the sand. The windward gauges of the cluster caught less rain than the leeward, but they also caught very much more sand, showing that the strong winds which carried the light raindrops on beyond to the leeward gauges also stirred up the light surface sand and were just able to drop this into the windward gauges.

8. The numerical results of all rainfall observations at different elevations of the gauge have been collected by me in a memoir read before the Philosophical Society of Washington, in December, 1888; most of these are also given in the excellent memoir of Wild, in volume IX. of his *Repertorium*, 1885. These observations represent many years of rainfall in a great variety of climates in the United States and Western Europe, and continued as they were through summer and winter, they represent the average effects (due to the average proportions between the precipitations that descend rapidly and slowly with the accompanying winds) characteristic of the respective climates. The following table shows the numerical results. In the fourth column are given the catch of the respective gauges expressed in percentage of the catch of the normal pit-gauge; the fifth column gives the deficit of this percentage; the sixth column gives the square root of the altitude.

Now, the studies of Archibald and Stevenson have shown that for small altitudes the velocity of the wind increases very nearly as the square root of the altitude. If, therefore, our deficits are proportional to the wind, they should be proportional to the numbers in the sixth column. This turns out to be the case so exactly that the formula

$$\text{Deficit} = 6 \text{ per cent.} \times \sqrt{\text{altitude in meters } P}$$

almost perfectly represents the deficits given in the fifth column.

Although the co-efficient 6 thus closely represents the average of many years' work, yet it cannot be safely adopted for any one locality, or even for any one year, since it involves the proportions of rain, snow and wind that actually occurred during the observa-

tions above summarized ; much less can it be adopted for any given month in the year, or any given storm. On the other hand, I conclude that for each wind, and for each style of precipitation, and for each style of gauge, there must be a special co-efficient to replace the figure 6. In other words, the co-efficient must be known for each individual rainfall or snowfall.

Location.	No. of Years.	Altitude. in Meters.	Relative Catch.	Relative Deficit.	Square Root of Altitude	$\sqrt{Alt}$
.....		0	100	0	0	0
Calne (5 and 8 inch gauges)	4	1	90	10	1.00	6
Castleton (5 and 8 inch gauges)...	3	2	88	12	1.41	8
Rotherham (5 inch gauges)	8	3	86	14	1.75	10
St. Petersburg (10 inch gauges)..	10	4	85	15	2.00	12
.....		5	85	15	2.24	13
.....		6	84	16	2.45	15
London (Westminster Abbey) ...	1	9	77	79	21	3.61
Enden	2	11	72			
St. Petersburg (Cent. Obs.)	1	13	68			
York (Museum)	3	13	80			
Calcutta (Alipore Obs.)	7	15	87			
Walton-on-Thames (Woodside) ..	1	15	73	64	36	5.29
Philadelphia (Frankfort Arsenal)	5	16	95			
Sheerness (Water Works).....	3	21	52			
Whitehaven (St. James's Church)	10	24	66			
St. Petersburg (Cent. Obs.)	10	25	59			
Paris (Astronomical Obs.).....	40	27	31	58	42	7.68
Dublin (Monkstown)	6	27	64			
Oxford (Radcliffe Obs.)	8	34	59			
Copenhagen (Observatory).....	4	36	67			
London (Westminster Abbey) ...	1	46	52	59	42	7.68
Chester (Lead Works).....	2	49	61			
Wolverhampton (Water Works)	3	55	69			
York Minster (Tower).....	3	65	60			
Boston (St. Botolph Church).....	2	79	47			

9. It is not difficult to devise a method of ascertaining this co-efficient at any moment. We have simply to establish two gauges at different heights, but near each other, and then, if they do not interfere with each other, and if the relative number of fine and large drops is the same at their respective elevations, and if the relative force of the wind at their mouths is known, we easily have the solution of the problem. If the gauges be placed above the roof of a flat building, we shall get the rainfall on that roof instead of on the ground.

It would be best to directly measure the relative wind velocity for each gauge-mouth by appropriate anemometers, or if this be not practicable, and if we have to assume some law, such as Archibald's, connecting wind and altitude, then it would be an improvement to use

three or more gauges at different altitudes, so as to check this assumption, and determine the extent to which for any shower the deficit depends on the square or other function of the velocity, rather than on the simple velocity itself. But assuming, for simplicity, that only two gauges are used, our method of procedure would consist in measuring the catch of the gauges placed at different heights for each storm or each hour, and substituting these results as the known data in the simple equation that connects these with the respective wind velocities. This equation is—

$$\begin{aligned} \text{Catch of gauge} &= \text{Catch of normal pit-gauge} \times (1 - k \sqrt{\text{altitude}}) \\ \text{or} \quad c &= P (1 - k \sqrt{h}) \end{aligned}$$

Two values, c_1 and c_2 for two altitudes h_1 and h_2 , give us two equations, from which, by elimination, we determine P and k for each individual case. Of course, the values of k are of minor importance to the climatologist and the ordinary observer, who will be content to compute the value of P for each measured rainfall, and will enter it in the proper column of his daily register as the corrected precipitation, comparable in its scientific value with his corrected pressure or temperature.

The formula for this computation is easily deduced by elimination, and may be put in the following form, where c_1 and h_1 belong to the upper gauge :—

$$P = c_1 + \frac{1}{\frac{\sqrt{h_2}}{h_1} - 1} (c_1 - c_2)$$

The gauges being permanent as to their altitudes, and so high that any winter snow will not materially change the h_1 and h_2 , we may assume their ratio to be constant. Some one of the following combinations will naturally occur to the observer :—

$$\text{For altitude } \left\{ \begin{array}{l} 1 \text{ and } 4 \\ 2 \text{ and } 8 \\ 3 \text{ and } 12 \\ \text{\&c.} \end{array} \right\} \quad P = c_1 + (c_1 - c_2)$$

$$\text{For altitude } \left\{ \begin{array}{l} 1 \text{ and } 9 \\ 2 \text{ and } 18 \\ \text{\&c.} \end{array} \right\} \quad P = c_1 + \frac{1}{2} (c_1 - c_2)$$

$$\text{For altitude } \left\{ \begin{array}{l} 1 \text{ and } 16 \\ 2 \text{ and } 32 \\ \text{\&c.} \end{array} \right\} \quad P = c_1 + \frac{1}{3} (c_1 - c_2)$$

Thus from measured rainfalls of 2.11 and 1.96 units caught in gauges at elevations of 1 and 4 units, we find the rainfall to be 2.26 units; whereas if for gauges at elevations of 1 and 16 units we had measured 2.11 and 1.60, we should have computed the true rainfall to be 2.28 units.

10. We have thus provided for the approximate correction of the rain-gauge readings for the very large source of error introduced by the wind and the slowness of fall of the drops, and we find that this correction is, even for low gauges, quite as large as the quantities about which climatologists have had so much discussion, viz., the effect of forests and buildings, of the hour of the day, of the cultivation of land, of the sun-spots, and other suggested influences. None of these subjects can be properly studied until we correct the original catch of the gauge for the large error due to the influence of the wind. But the wind influence does not depend on altitude only, that is to say, the correction deducted for any pair of gauges at one spot cannot be transferred to a similar pair at a short distance, because the winds at that new position, during the falling of the rain, may have been different from those prevailing at the former location. A pair of gauges must be established and observed at every spot whose rainfall we would determine.

This leads me to remark that in such a case as is afforded by the valuable observations in the experimental rain field at Berlin, it is probable that the moderate differences in the horizontal distribution of rain are comparable with the differences due to the distribution of wind, so that the study of the uncorrected gauge readings is really a study into the effect of local winds on the catch of the gauge, and, in general, gauge readings do not show the geographical distribution of rain until they are corrected for the effect of the wind at the mouth of the gauge as for an instrumental error.

In the case of gauges placed above forests, the measured quantities will increase as the forests grow taller, because the gauges come to be nearer the level and shelter of the tree tops; a gauge within the foliage of a tree should have a correction nearly the same as one near the ground, because of the diminished force of the wind in its neighbourhood.

Professors Joseph Henry and F. E. Nipher have advocated the use of "shielded gauges," and Börnstein has advocated "protected gauges," all so constructed that eddies about the mouths are largely diminished. Such gauges, therefore, have smaller corrections than the simple cylinders, and a pair of such gauges mounted at different altitudes would give an excellent arrangement for studying the peculiarities of rainfall.

In the preceding, I have assumed that the rain at the level of each gauge contains an equal proportion of the small drops due to spattering and drifting, but this is not true for very low gauges, or for drifting snow, and a special discussion of that subject is reserved for future study.

TEMPERATURE OF RIVERS, &c.

The committee on variations of temperature in lakes, rivers and estuaries, reported that no formal meeting had been held, but some of the members had occasionally met informally, and the whole com-

mittee had been consulted by letter on all the arrangements which had been made. It is inadvisable to attempt at present to summarise the results of observations made, as, although more than a year's observations are available on some rivers, it is only a few months since the work was begun on others. At the end of another year it is expected that sufficient data will be found to justify a comprehensive report on the subject. Several members of the committee have taken much trouble in collecting observations. Dr. Sorby has collected and discussed a great mass of temperature observations which he had made from his yacht *Glimpse* in the estuaries of the south-east of England during the summer months of five successive years. That will be published separately. Prof. Fitzgerald took charge of the observations in Ireland, where he induced a number of observers to take up the work. Mr. Willis Bund had already inaugurated similar researches on the Severn. Rev. C. J. Steward and Mr. Isaac Roberts rendered important services in their districts. The committee have to thank Mr. John Gunn for his services in forwarding thermometers and observation books and corresponding with observers. The committee ask to be re-appointed with the addition of the name of the Rev. Mr. Andson, and with a grant of £50.

SOLAR RADIATION.

The Committee on Solar Radiation reported that the actinometer devised by the late Prof. Stewart for the continuous measurement of solar radiation, which was described in the report of the Association for 1887, is now ready for the preliminary trials, the internal thermometer with a flat bulb of green glass having been made since the date of that report. The construction of this thermometer occasioned more trouble than had been anticipated. No attempt has at present been made to render the instrument self-recording, as it would obviously be unwise to incur the outlay which any construction for this purpose would involve, unless the results of preliminary trials were such as to encourage a hope that the instrument might be really useful if rendered self-recording.

(To be continued.)

WATERSPOUTS.

To the Editor of the *Meteorological Magazine*.

SIR,—It is, I believe, well authenticated that electrical phenomena are sometimes observed in connection with waterspouts; but are we therefore at liberty to conclude that they are formed by electricity? I think it is an effect rather than a cause, and it may be doubted whether electricity causes, at least directly, any phenomena besides those which we at once recognise as strictly its own.

A waterspout is a whirlwind at sea, and a whirlwind on land may become a waterspout at sea—at least I suppose so, as I have myself seen one lift water out of the river in the act of crossing it, which afterwards sped across a meadow, lifted a couple of sheep over a fence of hurdles, and deluged everything in its course. This was a very

local affair and was quickly over. The whirl was formed in a gully between two hills by cross currents of air ; it lifted the water 80 or 100 feet, and then, as its force was soon spent, the lateral translation of the water ceased and it fell almost all together. The whole force was purely mechanical, and as I know well every foot of ground where the whirlwinds occurred which are described in the August number (p. 107), I should, without hesitation, explain them in the same way. I could therefore allow very easily that rain might be saline, but not hail, and the evidence for this does not seem to be well authenticated.

Arriving once at Freshwater Bay in the Isle of Wight, on my first view of the sea, I saw a waterspout in the act of drawing up to the cloud ; the cloud to which it was attached was carried by a westerly wind across the island, and, as informed by a local paper, it formed again, letting itself down to the sea on the eastern side of the island. How is this to be explained ? I should say the formation of the high land forbade the continuance of the whirl in the lower half, making it for the time mechanically impossible ; and when the obstruction ceased, being continued above all the time, the motion was again prolonged downwards to the sea.—Yours truly,

JOHN SLATTER.

Whitchurch Rectory, Oxon, 18th September, 1889.

EARTHQUAKE IN CORNWALL, OCT. 7TH.

A shock of earthquake, extending from Doublebois to Boscastle, occurred yesterday, Oct. 7th, at about a quarter to two o'clock, and whilst some observers describe it as a slight shock, others speak of it as smart. At Doublebois station (between Liskeard and Bodmin Road) and in the neighbourhood, the phenomenon was noted by several persons. In the farmhouse of North Folly, about a mile from the railway station, the shock seems to have been more severely felt than elsewhere in that neighbourhood. The house itself seemed to vibrate, and the small articles rattled, some pieces of china being thrown down and broken. Further down the valley at Lewarne, the shock was spoken of as smart. It was very momentary, but attracted the attention of everyone in the house, and it appeared to come from the west. In Camelford a distinct vibration of the ground was felt by a large number of persons. Earthenware and other goods in the shop shook, and in some cases fell. The vibration was accompanied by a rumbling noise like thunder, which was heard for some seconds, and seemed to proceed from beneath the surface of the earth. Observers at Boscastle speak of two distinct shocks.—*Western Morning News*.

[The places named are somewhat far apart, Boscastle being about 17 miles N. of Doublebois ; the centre of disturbance seems to have been near Bodmin Moor, one of the highest and wildest parts of Cornwall.—Ed. M. M.]

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE FOR 1888.

STATIONS.	ABSOLUTE.				AVERAGE.						ABSOLUTE.		TOTAL RAIN.		AVER- AGE
	Maximum.		Minimum.		Max.	Min.	Mean.	Dew Point.	Humidity	Max. in Sun.	Min. on grass.	Depth.	Days.		
	Temp.	Date.	Temp.	Date.											
<i>Those in Italics are South of the Equator.</i>															
England, London	84.7	June 25	19.1	February 2	55.5	41.9	48.7	42.3	82	127.6	17.7	in.	173	0-10	
Malta	102.8	July 10	40.4	February 29	73.5	59.4	66.5	55.7	74	154.7	34.0	27.74	59	6.7	
<i>Cape of Good Hope</i>	99.2	January 28	35.5	July 19	70.5	54.1	62.3	...	...	...	...	13.75	101	3.5	
<i>Mauritius</i>	85.4	February 3	56.7	July 18	78.9	68.6	73.8	64.9	76	...	47.3	52.81	208	5.8	
Calcutta	106.6	June 14	48.3	January 31	86.4	70.5	78.5	68.4	67	165.4	15.7	69.71	103	4.4	
Ceylon, Colombo	93.4	February 1	66.0	February 8	86.9	74.8	80.9	71.4	77	154.0	57.4	101.08	174	5.4	
<i>Melbourne</i>	104.0	January 15	28.3	July 27	66.8	48.8	57.8	47.6	71	155.8	20.9	19.42	123	5.5	
<i>Adelaide</i>	107.5	December 25	33.7	August 7	73.7	54.0	63.8	47.6	67	160.6	23.5	14.57	131	4.6	
<i>Wellington</i>	73.3	January 4	35.0	July 5, 21	60.7	48.1	54.4	47.5	77	151.0	27.0	41.00	186	4.2	
Jamaica, Kingston..	94.6	July 28	59.6	January 5	89.0	70.1	79.5	70.7	74	...	...	40.81	...	...	
Toronto	92.0	June 22	-16.1	February 9	51.0	34.4	42.7	36.0	75	...	-23.0	26.26	191	6.2	
New Brunswick, { Frederickton	87.7	June 23	-22.0	January 28	48.6	29.4	39.0	33.1	72	...	...	47.56	187	6.1	
Manitoba, { Winnipeg	97.0	August 23	-46.4	February	43.6	21.1	32.3	28.1	80	...	...	16.89	139	5.1	
British Columbia, { Victoria	85.0	July 17	8.0	January 13	57.1	41.1	49.1	...	...	...	...	24.77	125	...	

SUMMARY.

<i>Highest Temperature in Shade</i>	107°·5 at Adelaide on December 25th.
<i>Lowest Temperature in Shade</i>	- 46°·4 at Winnipeg in February.
<i>Greatest Range in Year</i>	143°·4 at Winnipeg.
<i>Least Range in Year</i>	27°·4 at Colombo, Ceylon.
<i>Greatest Mean Daily Range</i>	22°·5 at Winnipeg.
<i>Least Mean Daily Range</i>	10°·3 at Mauritius.
<i>Highest Mean Temperature</i>	80°·9 at Colombo, Ceylon.
<i>Lowest Mean Temperature</i>	32°·3 at Winnipeg.
<i>Driest Station</i>	Adelaide, mean humidity 57.
<i>Dampest Station</i>	England, London, mean humidity 82.
<i>Highest Temperature in Sun</i>	165°·4 at Calcutta.
<i>Lowest Temperature on Grass</i>	- 23°·0 at Toronto.*
<i>Greatest Rainfall</i>	101·06 inches at Colombo, Ceylon.
<i>Least Rainfall</i>	13·75 inches at Malta.
<i>Most Cloudy Station</i>	England, London, average amount 6·7.
<i>Least Cloudy Station</i>	Malta, average amount 3·5.

* There being no grass min. thermometer at any other Canadian station.

TORRENTIAL RAINS IN BAVARIA.

To the Editor of the Meteorological Magazine.

SIR,—I see that in *British Rainfall*, 1888, you have dealt specially with intense falls of rain; I have gone through my records of the last four years, and find that there have been eight falls which you would have classed as exceptional, and of these, three are equal to those of such an intense character as to be set out on page 33 of the above-mentioned volume.

Grouping them in the order of their noteworthiness, they are as follows:—

Date,	Amount. in.	Duration. h. m.	Rate per hour. in.
1889, July 9th	·85	0 8	6·37
1886	·48	0 8½	3·38
1886, July 14th	·80	0 17½	2·74
1886	·82	0 37½	1·31
1886	·71	0 27½	1·56
1885	1·10	1 49	·60
1884	·52	0 26½	1·17
1884	·14	0 3½	2·40

I see that you regard the table on page 33 as the epitome of about 20,000 yearly records, and yet you have only 43 entries, or about 1 in 500. As I have three cases in 5 years, one of two facts is obvious—(a) torrential rains are much more frequent here than in the British Isles; or (b) your observers do not look out sharp enough.

Yours very truly,

MICHAEL FOSTER WARD.

Partenkirchen, Bavaria.

[We think that both causes are in operation. Col. Ward was always a very careful observer, and would rarely miss any phenomenon, and we believe that the storms in Bavaria are exceptionally severe.—Ed.]

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MARCH, 1889.

STATIONS. (Those in italics are outh of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	59·6	24	19·2	4	48·2	33·8	34·8	80	96·8	16·4	1·36	13	7·0
Malta	78·2	21	40·8	17	61·7	50·1	47·0	77	129·3	37·2	2·71	12	5·4
Cape of Good Hope ..	89·0	5	50·8	23	76·8	57·9	...	...	...	...	1·49	5	4·8
Mauritius	83·7	5, 27	72·0	7	81·4	74·8	72·3	84	137·3	64·1	17·09	26	7·7
Calcutta	98·3	27	60·8	6	91·6	69·7	68·0	62	154·5	51·0	·92	3	2·2
Bombay	94·3	6	70·0	3, 4	86·1	73·8	70·1	72	147·7	59·9	·00	0	2·3
Ceylon, Colombo	93·0	29	72·6	6	90·6	75·1	73·0	77	147·5	68·5	1·67	14	3·4
Melbourne	96·0	16	43·0	1	75·8	53·6	50·9	63	147·2	29·0	·24	5	5·0
Adelaide	102·0	16	49·6	20	81·6	60·2	51·3	50	151·0	40·9	·81	8	4·4
Wellington	73·0	3	43·2	26	65·5	52·9	50·7	73	131·0	35·0	3·97	12	4·3
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	92·5	29	60·0	2	88·6	68·7	69·3	73	...	...	5·43	...	...
Trinidad	95·5	12	62·0	27	90·6	70·1	70·5	72	158·5	54·0	4·16	...	...
Toronto	54·8	23	13·1	11	39·3	26·5	25·3	73	...	5·0	·99	9	6·1
New Brunswick, Fredericton	51·8	23	— 7·7	1	39·7	20·4	23·3	70	...	...	3·68	10	5·5
Manitoba, Winnipeg ...	61·8	23	— 14·1	13	38·2	15·4	22·6	78	...	...	·35	9	3·9
British Columbia, Victoria	64·0	26a	30·0	3	56·9	39·5	...	...	...	...	1·50	14	...

a And 29.

REMARKS, MARCH, 1889.

MALTA.—Mean temp. 54°·8; mean hourly velocity of wind 14·3 miles. Sea temp. ranged from 58°·5 to 60°·6. TS on 23rd, H on 6th and 17th. R nearly four times the average; wind 40 per cent. above average. J. SCOLES.

Mauritius.—Mean temp. of air 0°·1 below, mean dew point 2°·6 above, and E 9·32 in. above their respective averages. Mean hourly velocity of wind 12·4 miles, or 2·1 above average; extremes 31·1 on 11th and 1·7 on 3rd. Prevailing direction, E.S.E. to E. L on 4 days; T on 5 days. Local inundations from 9th to 11th and on 17th.

C. MELDRUM, F.R.S.

COLOMBO.—Thunderstorms on 7 days and L on 7 other days.

J. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 0°·7 above average; temp. of dew point 1°·2, humidity 5, amount of cloud 0·6, and E 1·87 in. below averages. Prevailing winds S.E., S.W., and S.; strong on 5 days. Heavy dew on 10 days and distant T on the 18th.

R. L. J. ELLERY, F.R.S.

Adelaide.—Pressure ·043 in. and temp. slightly above the average of 32 years. E a quarter of an inch less than the average.

C. TODD, F.R.S.

Wellington.—Generally showery during the month, with intervals of fine weather Prevailing wind N.W., strong on 8 days; gales on 8th and 22nd. Mean temp. 2°·9 below, E 1·15 in. above average.

R. B. GORE.

SUPPLEMENTARY TABLE OF RAINFALL,
 SEPTEMBER, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	...	XI.	Castle Malgwyn	2.77
"	Margate, Birchington...	1.06	"	Rhayader, Nantgwillt..	3.17
"	Littlehampton	.77	"	Carno, Tybrith	2.60
"	Hailsham	.74	"	Corwen, Rhug	1.63
"	Ryde, Thornbrough	...	"	Port Madoc	2.97
"	Alton, Ashdell	1.05	"	I. of Man, Douglas	2.78
III.	Oxford, Magdalen Col...	1.49	XII.	Stoneykirk, Ardwell Ho.	2.86
"	Banbury, Bloxham	2.05	"	New Galloway, Glenlee	2.13
"	Northampton	2.19	"	Melrose, Abbey Gate...	1.17
"	Cambridge, Beech Ho...	2.76	XIII.	N. Esk Res. [Penicuik]	1.50
"	Wisbech, Bank House..	2.38	XIV.	Ballantrae, Glendrishaig	2.99
IV.	Southend	2.36	"	Glasgow, Queen's Park.	1.22
"	Harlow, Sheering	2.85	XV.	Islay, Gruinart School..	3.51
"	Rendlesham Hall	1.83	XVI.	Dollar	1.00
"	Diss	3.00	"	St. Andrews, PilmourCot	.79
"	Swaffham	2.76	"	Balquhiddy, Stronvar..	1.57
V.	Salisbury, Alderbury...	1.16	"	Dunkeld, Inver Braan..	.77
"	Warminster	1.44	"	Dalnaspidal H.R.S. ...	1.93
"	Bishop's Cannings	1.35	XVII.	Keith H.R.S.	1.93
"	Ashburton, Holne Vic....	2.50	"	Forres H.R.S.	.98
"	Hatherleigh, Winsford.	1.09	XVIII.	Strome Ferry H.R.S....	4.31
"	Lynmouth, Glenthorne.	1.54	"	Fearn, Lower Pitkerrie.	.94
"	Probus, Lamellyn	1.72	"	Loch Shiel, Glenaladale	5.73
"	Launceston, S. Petherwin	1.95	"	N. Uist. Loch Maddy ...	4.07
"	Wincanton, Stowell Rec.	1.87	"	Invergarry	2.59
"	Taunton, Lydeard Ho...	1.53	"	Loch Ness, Drumnadrochit	1.19
"	Wells, Westbury	1.31	XIX.	Lairg H.R.S.	1.20
VI.	Bristol, Clifton	2.27	"	Forsinard H.R.S.	...
"	Ross	2.06	"	Watten H.R.S.	2.50
"	Wem, Clive Vicarage ...	2.12	XX.	Dunmanway, Coolkelure	3.34
"	Cheadle, The Heath Ho.	3.43	"	Fermoy, Gas Works ...	1.39
"	Worcester, Diglis Lock	1.49	"	Tipperary, Henry Street	1.38
"	Coventry, Coundon	3.01	"	Limerick, Kilcornan ...	1.10
VII.	Ketton Hall [Stamford]	2.28	"	Miltown Malbay	3.22
"	Grantham, Stainby	2.39	XXI.	Gorey, Courtown House	1.60
"	Horncastle, Bucknall ...	2.01	"	Navan, Balrath	1.33
"	Mansfield, St. John's St.	2.24	"	Mullingar, Belvedere ...	2.03
VIII.	Neston, Hinderton	2.96	"	Athlone, Twyford	1.45
"	Knutsford, Heathside ...	3.36	"	Longford, Currygrane...	2.39
"	Lancaster, South Road.	2.95	XXII.	Galway, Queen's Coll...	2.59
"	Broughton-in-Furness ..	4.96	"	Clifden, Kylemore	4.40
IX.	Wakefield Prison	1.07	"	Crossmolina, Enniscroe..	2.19
"	Ripon, Mickley	.79	"	Collooney, Markree Obs.	3.13
"	Scarborough, West Bank	1.00	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	.66	XXIII.	Warrenpoint	1.29
"	Middleton, Mickleton..	1.28	"	Seaford	2.03
X.	Haltwhistle, Unthank..	1.82	"	Belfast, New Barnsley..	3.31
"	Shap, Copy Hill	1.12	"	Bushmills, Dundarave...	3.72
XI.	Llanfrehfa Grange	2.98	"	Stewartstown	2.13
"	Llandovery	2.82	"	Bunorana	3.24

SEPTEMBER, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Days on which -01 or more fell.	Max.		Min.		In shade.	On grass.	
				Dpth.	Date.		Deg.	Date.	Deg.	Date.			
I.	London (Camden Square) ...	1.77	— .74	.73	24	10	80.3	11	35.1	23	0	4	
II.	Maidstone (Hunton Court)...	1.27	— 1.04	.57	8	8	...	...	...	...	...	...	
III.	Strathfield Turgies	1.89	— .91	.83	24	11	80.0	12	30.8	18	3	6	
III.	Hitchin	1.69	— .79	.61	24	13	74.0	11	38.0	17	0	...	
IV.	Winslow (Addington)	2.40	— .08	1.03	24	11	80.0	11	31.0	23	1	5	
IV.	Bury St. Edmunds (Westley) ...	3.48	+ .79	1.05	24	10	...	...	...	...	...	...	
V.	Norwich (Cossey)	3.29	+ .21	.91	24	10	70.0	1a	32.0	17	e	3	
V.	Weymouth (Langton Herring) ...	.88	...	.42	23	7	72.0	4	40.0	25	0	...	
"	Barnstaple	1.64	— 2.64	.56	23	7	83.0	13	37.0	23	0	...	
"	Bodmin (Fore Street)	1.89	— 3.30	.86	23	12	...	...	...	...	...	...	
VI.	Stroud (Upfield)	1.69	— 1.56	.70	23	10	80.0	12	38.0	20f	0	...	
"	Churchstretton (Woolstaston) ...	1.63	— 1.84	.78	23	14	77.0	12	38.0	25	0	1	
"	Tenbury (Orleton)	1.49	— 1.86	.86	23	10	81.6	12	29.5	18	2	4	
VII.	Leicester (Barkby)	2.29	— .41	1.06	23	13	80.0	11	30.0	17	4	5	
"	Boston	1.87	— .74	.58	23	10	78.0	11	28.0	22	...	...	
"	Healey Hall (Tickhill)	1.24	...	.62	23	10	75.0	10b	32.0	22g	2	...	
VIII.	Manchester (Plymouth Grove) ...	2.65	— 1.22	.54	26	13	76.0	10	35.0	25	0	2	
IX.	Wetherby (Ribston Hall) ...	1.15	— 1.93	.36	2	6	...	...	...	...	...	...	
"	Skipton (Arncliffe)	2.69	— 2.89	.57	18	15	72.0	7	33.0	22	0	...	
"	Hull (People's Park)	1.38	— 1.61	.35	23	13	...	...	...	...	...	...	
X.	North Shields	1.51	— .81	.80	11	12	70.5	10	32.0	22	1	4	
"	Borrowdale (Seathwaite)	8.31	— 4.91	2.43	26	14	...	...	...	...	...	...	
XI.	Cardiff (Ely)	2.11	— 2.69	1.20	23	9	...	...	...	...	...	...	
"	Haverfordwest	3.05	— 2.00	2.07	23	13	71.2	12	32.5	22	0	4	
"	Plinlimmon (Cwmsymlog) ...	4.18	...	1.56	19	13	...	...	...	...	...	...	
"	Llandudno	2.22	— 1.53	.45	18	13	72.2	12	42.2	18	0	...	
XII.	Cargen [Dumfries]	1.80	— 2.61	.66	18	11	73.4	6	30.0	22	1	...	
"	Jedburgh (Sunnyside)	1.39	— 1.20	.41	27	8	66.0	5c	32.0	22	1	...	
XIV.	Old Cumnock	3.50	— .99	.80	18	15	74.0	1	22.0?	21	6	...	
XV.	Lochgilhead (. memory)	3.59	— 2.17	.87	13	14	...	...	...	...	...	...	
"	Oban (Craigvarre)	2.37	...	.71	18	17	70.0	6	33.3	24	0	2	
"	Mull (Quinish)	3.85	...	.84	17	21	...	...	...	...	...	...	
XVI.	Loch Leven Sluices	.80	— 2.43	.40	19	5	...	...	...	...	...	...	
"	Dundee (Eastern Necropolis) ...	.60	— 2.34	.25	18	7	69.8	10	34.0	24	0	...	
XVII.	Braemar	1.03	— 2.91	.27	18	13	70.0	6	30.0	24	1	11	
"	Aberdeen (Cranford)	.99	...	.38	18	15	70.0	9d	34.0	25	0	...	
XVIII.	Lochbroom	3.98	...	.76	19	15	...	...	...	...	...	...	
"	Culloden	1.15	— 1.75	...	...	...	68.0	7, 10	33.0	25	0	7	
XIX.	Dunrobin	1.87	...	.46	10	10	66.5	9	34.0	26	0	...	
"	S. Ronaldsay (Roeberry)	2.07	— 1.16	.66	10	16	63.0	4	38.0	24	0	...	
XX.	Cork (Blackrock)	.99	— 3.16	.48	23	12	70.0	8, 14	39.0	24	0	...	
"	Dromore Castle	2.45	...	.63	23	14	75.0	12	41.0	29	0	...	
"	Waterford (Brook Lodge) ...	.85	...	.35	23	10	69.5	3	39.0	18h	0	...	
"	O'Briensbridge (Ross)	1.23	...	.18	23	13	71.0	1	40.0	30	0	...	
XXI.	Carlow (Browne's Hill)	.81	— 2.45	.21	18	11	...	...	...	...	...	...	
"	Dublin (Fitz William Square) ...	1.04	— 1.37	.35	23	13	69.7	11	38.9	25	0	1	
XXII.	Ballinasloe	1.44	— 2.52	.38	10	16	69.0	12	35.0	25	0	...	
XXIII.	Waringstown	2.17	— 1.18	.53	11	15	74.0	5	35.0	22i	0	4	
"	Londonderry (Creggan Res.) ..	3.81	...	1.15	26	20	...	...	...	...	...	...	
"	Omagh (Edenfel)	2.51	— 1.53	.50	26	18	69.0	12	38.0	22	0	...	

a And 11, 14. b And 11. c And 14. d And 10, 11. e And 18, 22. f And 25. g And 23.

h And 23, 25, 26. i And 24.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—We have seldom experienced a finer September. Coming after a showery August, unsuitable for harvesting, it gave full recompense for the shortcomings of that month. A sharp touch of frost occurred on the 17th, 18th and 19th, and rough weather prevailed from the 24th to the 27th.

ADDINGTON.—Taken altogether, it was a fine month, and very warm from the 9th to the 13th. Little R fell until the 23rd, when there was a good steady downpour from about 10 p.m. on the 23rd, to the afternoon of the 24th, 1·96 in. falling in the two days. Frost occurred rather early, tender plants being injured on the 18th, and some quite destroyed on the 23rd.

BURY ST. EDMUND'S, WESTLEY.—The month was remarkable for the severe TS on the night of the 2nd, when an inch of R fell in a very short time; also for the 1·76 in., which all fell on the 24th, though measured in two days.

LANGTON HERRING.—The first half of the month was very warm, the mean temp. exceeding that of August. In the latter half, the temp. was low, and there were several nights on which there was white frost. The mean temp. at 9 a.m. was 0°·5 above the average. Solar halo on the 8th; fogs on the 9th and 13th; heavy dews on 11th, 13th and 15th.

WOOLSTASTON.—A perfect harvest month. The second week was very hot, the max. temp. on the 12th being the highest recorded during the year. Mean temp. 54°·5.

ORLETON.—The first half of the month was very fine and dry, with a temp. above the average. The remainder of the month, excepting the 26th and 27th, was much cooler than the average, with rough, cold and variable winds, the mean for the whole month being about 0°·4 below the average of 28 years. Frosts occurred on the mornings of the 18th and 23rd, and fogs on the mornings of the 2nd, 8th and 13th. The R nearly all fell after the 18th, and no T or L was recorded. The weather was favourable for gathering the hops, and securing the late harvest.

MANCHESTER, PLYMOUTH GROVE.—During the first 12 days summer weather prevailed, the 16th, 17th, 18th, 22nd, 25th, and 29th were fine autumn days, and the rest of the month was wet and cold. T, L and H on 20th.

HULL.—The weather was at times showery, but there were long periods of fine bright autumnal weather.

WALES.

HAVERFORDWEST.—The month commenced with high temp., southerly wind, cloud, and some fog. After the 5th, the air cleared, and fine bright summer-like weather prevailed to the 17th; cold nights occurred about the 15th, with a decided fall of temp., which continued to the end of the month, a sharp frost occurring on the 22nd, followed by an unusually heavy R, 2·00 in. in less than 10 hours. Crops of all kinds splendid, and harvest got in in fine order; such a season has not been remembered for many a long year. Temp. at or above 70° on 4 days; much bright sunshine during the first 3 weeks.

SCOTLAND.

CARLEN.—The difference in the temp. of the first and second halves of the month was remarkable. For the first 14 days the mean temp. was 58°·8, being 2°·2 above the average for June, and 0°·4 above that of August. The latter half of the month was unusually cold, bringing down the mean temp. of

the month nearly 1° below the average. Cold nights occurred on the 21st, 22nd, and 23rd, frosting down vegetation; a warm wave followed on the 27th and 28th. E. winds prevalent; sunshine below the average.

JEDBURGH.—The weather during the month was seasonable and favourable for ingathering corn, which, except in high districts, was nearly completed at the close. The turnip and potato crops look well, and grass is abundant.

CRAIGVARRAN, OBAN.—On the whole a fair month, with liberal showers of much benefit to stock and growth. Temp. high during the first half, and low during the second. Very early S on hills on 21st, with a cold wave full a week earlier than before noted.

LOCHBROOM.—The first half of the month was beautiful, enabling the farmer and the crofter to secure their crops in splendid condition; but from the 16th to the end it was stormy and cold in the extreme, E rattling about our ears on many occasions, and S on the hills nearly down to our houses. Seldom have we seen so sudden a change as took place about the 17th.

INVERNESS, CULLODEN.—The month generally was fine, with a dry period from the 1st to the 20th.

ROBBERY.—The first half of the month was fine, the second half cold and unsettled.

IRELAND.

CORK.—On the whole, a fine but frequently not a bright month. Mean temp. ($57^{\circ} \cdot 6$) $4^{\circ} \cdot 0$ below the average.

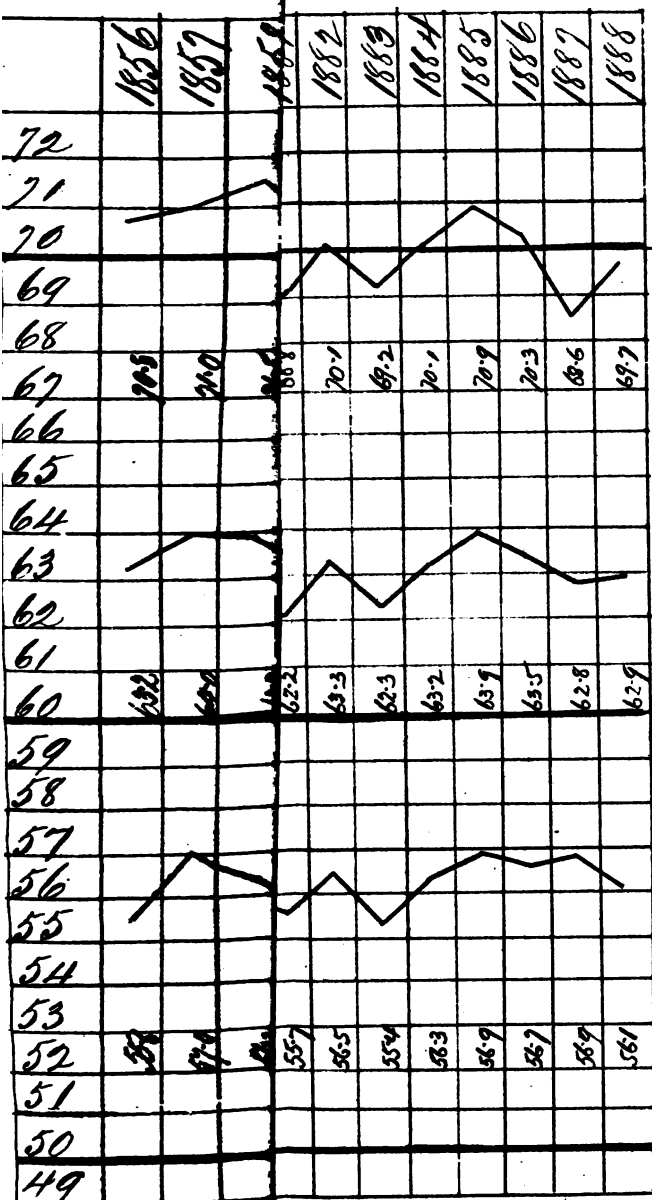
WATERFORD.—E $2 \cdot 68$ in. below the average. Mean temp. $56^{\circ} \cdot 1$. Fog on 5th, 10th, 11th and 12th.

DUBLIN.—A fine month, with high mean pressure, winds from polar quarters—chiefly N.W.—a moderate E, and a normal temp. At the beginning, fogs were prevalent along the coast, and towards the close, strong and squally winds occurred on several days. High winds on 7 days; gale on 18th. Mean humidity 87; mean amount of cloud $6 \cdot 2$.

WARINGTOWN.—Strong drying northerly winds prevailed during the last fortnight of the month, which prevented the E from materially retarding harvest operations.

EDENFEL, OMAGH.—With the exception of the 8th, 10th, and 11th, the first half of the month was fine, warm and favourable, and enabled the greater part of an excellent harvest to be secured in good condition. The remainder of the month was squally, wet and unsettled, with more or less heavy E on every day but the last. Swallows last seen on 27th.

Diary N.S.W.



Max Temp

Mean Temp

Min Temp

McRussell
and 29 11

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXVI.] NOVEMBER, 1889. [PRICE FOURPENCE,
or 5s. per ann. post free.

THE FLOATING ISLAND IN LAKE DERWENTWATER.

BY PROF. RAPHAEL MELDOLA, F.R.S.

As there still appears to be a certain amount of mystery attaching to this remarkable phenomenon, so well described by Mr. G. J. Symons in his interesting little work published last year,* I am induced to offer for the consideration of those interested in the subject some ideas which occurred to me on reading Mr. Symons's investigation, and which I have recently had the advantage of discussing with the author himself. It must be assumed that the majority of the readers of this Magazine are sufficiently acquainted with the results arrived at by Mr. Symons, to render a recapitulation of them unnecessary here.

The immediate cause of the rising of the mass of vegetable matter has been shown by the investigation to be the gases, consisting chiefly of marsh gas with a smaller proportion of nitrogen, entangled among the peat. The problem therefore resolves itself into ascertaining the source of these gases. If it could be shown with any probability that a subterranean source of the gases exists under the islands, the mystery would be at once solved, but there is unfortunately no evidence for such a belief, and it is generally admitted that it is unscientific to invoke unknown causes until all feasible explanations have failed. There is, moreover, much antecedent improbability against this view, since the emanation of marsh gas from fissures in strata as old as the Silurian is a phenomenon unknown, as far as I am aware, in this part of the world. I speak, of course, subject to correction by geologists on this point. It is true that some of the Canadian petroleum deposits occur in pre-Silurian strata, but when marsh gas can come to the surface from a petroleum deposit, it generally brings up hydrocarbon oils with it, and to my knowledge nothing of the kind has ever been observed on Derwentwater. The various theories which have been proposed to account for the phenomenon

* The Floating Island in Derwentwater, its History and Mystery, by G. J. Symons, F.R.S. Stanford.

have been so ably discussed by Mr. Symons that readers need only be referred to his work. Of these theories, the one which I hold to be the most natural, is that which attributes the flotation of the peat bed to the gases engendered by its own decomposition. This is substantially the view put forward in 1801 by "D. J. P." in the *Phil. Mag.*, vol. xi., and reiterated by Otley and Dalton in 1814-1830. The chief objections to this view, as I learn from Mr. Symons, are : 1st, that it does not explain why similar floating islands do not occur elsewhere where similar conditions, viz., a peat bed on a lake bottom, prevail ; 2nd, that it fails to account for the long succession of recorded appearances of the island from 1773 down to the present time.

Respecting the first objection it must be observed that the essential (mechanical) conditions may, after all, be of very rare occurrence. What is required is a bed of peat resting on a sufficiently friable foundation to enable it to tear away from its basement when the specific gravity is sufficiently reduced by the entangled gas. This condition has been shown to exist in the Derwentwater deposit, but it cannot be assumed from this that similar conditions should be expected to prevail in other lakes. The peat bed which forms the floating island appears to be resting on a loose delta-deposit. It is not unlikely that the currents from the inflowing streams, the Lodore and the Cat Gill Beck, may keep this deposit in the necessary condition of looseness, and may prevent the peat bed from ever becoming firmly anchored to the bottom. For these reasons this first objection does not appear to me to possess much weight.

The second objection is the one which has really been instrumental in causing me to venture to touch upon the subject. It has seemed improbable to some writers that the peat should continue to evolve gas for so long a period. Thus Otley (as quoted by Mr. Symons) says that on the view that the gas is produced by the decomposition of the vegetable matter, "the process of forming gas must apparently reach a maximum and then gradually cease." Now we may fully admit this as an abstract proposition, but it seems to me quite impossible to define this maximum. There is no *a priori* reason why a deposit of peat should not go on evolving marsh gas and nitrogen for a century or for two centuries, especially when, as in the present case, the bed is added to from time to time by growth on its surface. The whole question turns upon the point as to how long a mass of vegetation decaying under water could go on evolving marsh gas, &c. Unfortunately we have very few data to furnish exact information on this point, but I have made certain calculations which I submit to the consideration of the readers of the Magazine for whatever they may be worth.

In the first place, with respect to the specific gravity of peat I can get but very scanty information, but the best authorities that I have been enabled to consult give it as about 1.2 for the denser kinds. We shall not be far wrong if we suppose that 10

cubic centimetres of peat freed from adhering water weigh 12 grammes. According to the average of numerous analyses, peat of this kind contains about 4·5 per cent. of hydrogen not in the form of water, 40 per cent of carbon, and about 1 to 1·5 per cent. of nitrogen. Supposing the whole of the hydrogen in peat to be evolved as marsh gas in the process of decay, one part by weight of hydrogen would yield four parts of this gas, so that 10 cubic centimetres of peat weighing 12 grammes and containing 0·54 gramme of hydrogen would yield 2·16 grammes of marsh gas. There is, however, no warrant for the belief that the whole of the hydrogen is converted into marsh gas, so that it will be safer to begin by assuming that only one half of the hydrogen—say 0·27 grammes—is evolved in this form. Then it will be found that this quantity of gas weighing 1·08 grammes at 0° C. and 760 mm. bar. occupies 1,500 cubic centimetres. At ordinary atmospheric temperature (15° C.) this volume becomes 1,582 cubic centimetres. The final result is that if we suppose only one half of the available hydrogen to be evolved as marsh gas, a given volume of peat would furnish over 150 times its volume of gas, so that if only one-tenth of the whole quantity of hydrogen were evolved as marsh gas there would still be a volume of gas greater than that of the volume of peat decomposed. The density of marsh gas as compared with water is approximately ·0007, so that the decay of an extremely minute quantity of peat would give enough gas to float the bed.

All these considerations tend to prove that the early explanation is the correct one, and that no great stretching of hypothesis is necessary to account for the facts. The circumstance that a moderately elevated temperature is most favourable to the appearance of the island is distinctly in accordance with the view here advocated, since the decomposition of vegetable matter under water is well known to proceed most rapidly in warm weather. The only point in which the present case differs from the ordinary evolution of marsh gas in stagnant ponds is that the mass of vegetable matter is sufficiently coherent to retain the gas bubbles, and to rise and sink as a whole. The periodicity of the phenomenon simply represents the intervals of time necessary for the bed to accumulate a sufficient charge of gas to raise it from its basement. When the mass rises, the gas, relieved from the pressure of water, gradually escapes, and the island sinks till the accumulated gas again diminishes the specific gravity of the whole to the critical point of flotation. The only observable effect upon the peat bed would be that in course of time it would become slightly richer in carbon and poorer in hydrogen; in fact, just the change in chemical composition which is known to take place in the transformation of peat into lignite.

THE AUTUMN CONGRESSES.

THE BRITISH ASSOCIATION AT MANCHESTER.

(Continued from page 136.)

THE DETERMINATION OF THE AMOUNT OF RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—There seem to be two or three errors (typographical ?) in the important paper of Prof. Cleveland Abbe in your October number. On page 133, the heading of the last column apparently should be—

$$6 \times \sqrt{\text{alt.}}$$

and the formula in the middle of page 134 should read $\sqrt{h_1}$ as well as $\sqrt{h_2}$, i.e.—

$$P = c_1 + \frac{1}{\sqrt{\frac{h_2}{h_1}} - 1} (c_1 - c_2)$$

There is a further misprint in the 12th line of page 135, for “deducted” read “deduced.”—Yours truly,

T. W. BACKHOUSE.

[Mr. Backhouse is, we believe, perfectly right.—ED.]

ATMOSPHERIC ELECTRICITY.

A paper on “Atmospheric Electricity,” by Prof. L. Weber was read, in which he gave results of experiments made by flying kites and by sending up balloons to which wires were attached leading to a galvanometer whose other terminal was put to earth. The results were given only for twelve bright summer days on which there were no clouds; the results on those days on which clouds prevailed having brought in various perturbations are reserved for discussion on a future occasion. The intensity of the currents was plotted, and it was found that the higher the kite went the more intense the current became. Up to 300 ft. the current was in a negative direction.

Prof. C. Michie Smith also read a paper entitled “Notes on Atmospheric Electricity, and the use of Sir W. Thomson’s Portable Electrometer.” In the course of his remarks he said that usually they had in Madras during September frequent magnificent displays of sheet lightning, and he had often made electrometer observations from the top of his house while these displays were in progress. In some cases an evident effect was produced on the electrification of the air, but in general it was found that the electrification was normal. This pointed to the conclusion that so-called sheet lightning might be divided into two classes. There was the reflection of distant lightning seen on the clouds or on the sky, but there was also, and it could be easily distinguished from the former, a series of discharges going on between two neighbouring masses of cloud.

These discharges often took the brush form. At other times, fine flashes might be seen lighting up the whole mass of the cloud, and at times a large series of discharges almost parallel and simultaneous pass between the two cloud banks. Such discharges taking place at a considerable distance did not sensibly affect the electrometer. On the other hand, when the sheet lightning was simply the reflection from distant flashes, the electrometer was usually strongly influenced. From his own experience of thirteen years of the portable electrometer, he found that the instrument must be very differently treated in damp tropical climates to what was necessary in this country. The observer must be content with much less complete insulation. In the first place, the pumice must be charged with a much larger quantity of acid—as much as it would absorb without showing a moist surface. This involved more frequent drying, and he found that about once a fortnight was long enough to leave it. The greatest difficulty, however, was in charging the instrument at all. It was almost hopeless to attempt it with the small electrophorus supplied with it, and even when an electrical machine of any kind was used the greatest care was required in drying the charging end. Recharging was necessary every three or four days. He mentioned these things as he found that the neglect of the precautions had caused many people to think that the use of the portable electrometer in India was impossible.

SUNSHINE AND RAINFALL AT BEN NEVIS.

The registrations of the sunshine recorder at Ben Nevis Observatory showed 970 hours of sunshine during the year, the smallest number of hours for any month being 8 for November, and the largest 250 in June, being nearly half the possible sunshine. The number of hours for the four years now observed beginning with 1885, were 680, 576, 898, and 970. The contrast of the sunshine of 1886 with that of 1888 is thus very striking. The amount of the rainfall for the year was 132·46 in., the month of least rainfall, 3·76 in., being June, and the greatest, 20·60 in., being November. The number of days on which precipitation was nil, or less than the hundredth of an inch, was 118. The number of rainless days for the three last years have been 159, 128, and 118. From all the observations yet made, it is seen that a fall, equalling at least 1·00 a day, has occurred on an average of one day in nine. Atmospheric pressure was this year again above the annual average, the mean at sea-level being 29·889, or 0·055 higher. The lowest mean at the observatory, 25·035 in., occurred in March, and the highest, 25·590 in., in September; the difference being 0·555 in. At sea-level at Fort William, the extreme monthly means were 29·636 in. in November, and 30·132 in September; the difference being 0·496 in.

BLACK BULB IN VACUO.

Prof. McLeod, F.R.S., in a paper on the black-bulb thermometer *in vacuo*, concludes that the black bulbs should be as small as possible,

and very little of the stem blackened, and also that the case should be as thin as is consistent with strength.

DARK LIGHTNING FLASHES.

Mr. A. W. Clayden read a paper on dark flashes of lightning. The author exhibited a negative taken on June 6th last, which shows several reversed images of lightning-flashes. He described a series of experiments which he had carried on with the object of discovering whether the phenomenon could be imitated in the laboratory. The steps in the investigation were illustrated by a series of negatives showing photographs of electric sparks. The conclusions arrived at are, that photographic images of electric sparks can be reversed by the action of diffused light. Reversal is only produced when the exposure to diffused light is subsequent to (or possibly simultaneous with) exposure to the image of the spark. If the plate is first acted upon by diffused light, the sparks give a direct image unless the action has been considerable, in which case they seem to make no impression.

CONGRÈS INTERNATIONAL MÉTÉOROLOGIQUE.

In the notice of the programme of the above congress which we printed in July last we predicted that it could not be carried out, and our prediction was fulfilled. But nevertheless the Congress must be pronounced to have been a success, both for the eminence of many of the men who attended it, and because of the excellence of some of the papers. We have not a list of the members, but if we name in alphabetical order some of those who accepted the invitation of the French Meteorological Society, it will be seen that the gathering was an interesting and probably useful and important one:—

R. Billwiller...Switzerland
L. Cruls.....Rio de Janeiro
G. G. Davis ...Buenos Aires
M. Dechevrens. Zi Ka Wei, Shanghai
F. Denza Turin
B. A. Gould...Buenos Aires

S. Hepites Bucharest
H. H. Hildebrandsson..Upsala
A. Paulsen Copenhagen
A. L. Rotch Blue Hill, U.S.A.
G. J. Symons.....London
Y. Wada Tokio, Japan.

Of French meteorologists nearly all the leading men were there.

The inaugural meeting was held in the Trocadéro, M. le Prof. Mascart opening the proceedings by welcoming the members on behalf of the Minister of Public Instruction. Mr. Symons then proposed that M. Renou, director of the Observatory at Parc St. Maur and President de la Soc. Mét. de France, be elected president of the Congress. This was carried by acclamation, and M. Renou took the chair and delivered an address. Subsequently the vice-presidents and other officers were appointed and the meeting was closed. The subsequent sectional meetings were held in the rooms of the Physical Society, 44, rue de Rennes.

We do not intend to report upon the work done, because we know that one of the editors of the *American Meteorological Journal* took very careful notes and that an interesting abridgment will appear in that journal. There is no advantage in printing twice where once will suffice, and we therefore advise our readers to buy the November and December numbers of, if they are not already subscribers to, that publication.

And we have another suggestion to make, but as it involves the expenditure of half a sovereign, everybody may not be willing to adopt it. The papers sent in were both numerous and important, more so than was anticipated when the arrangements were originally made and the membership fee, entitling the member to a copy of all the reports, was fixed at 12 francs. It is doubtful whether the subscriptions already received will meet the cost of all this printing, and as no more copies of the reports will be printed than are subscribed for, those who desire to help a good work, and also to receive a valuable report should send a money order on Paris for 10s. to M. E. Renou, Prés. Soc. Mét. de France, 7, rue des Grands Augustins, Paris.

The ordinary meetings commenced on Friday, September 20th, and continued until the 25th. Four special visits were made—(1) to the Bureau Central, where Prof. Mascart not only explained all the ordinary working of his establishment now at last very commodiously housed, but also showed several charming experiments illustrative of the formation and action of whirlwinds, waterspouts, and dust storms; (2) to the remarkable collection of self-recording apparatus shown in the Exposition by MM. Richard Frères; (3) to the Meteorological Observatory at Parc St. Maur, where the Congressists were received by M. Renou, and subsequently shown the magnetic instruments by M. Mourreaux; (4) to the private part of the Eiffel Tower, at the extreme top of which MM. Richard Frères have established quite a meteorological observatory.

THE SANITARY INSTITUTE.

The meetings of this body show one curious feature—they are always best in Cathedral cities. It is not for us to spend much time in explaining or moralizing about the fact. It may be due to the desire of the clergy to render healthier and happier the homes of their poorer brethren; it may be due to the fact that generally the struggle for life—or shall we say for money—is less fierce than in other towns; we know not, we chronicle the fact, and pass on to the meteorology. The section for Meteorology, Chemistry, and Geology was fortunate in having for president one of the oldest medical officers of health, and a past president and the council secretary of the Royal Meteorological Society. Dr. Tripe's Address, entitled "Winds, with some remarks on their sanitary effects," dealt not only with the great general movements of the atmosphere, the trades, &c., but also with the exceptional ones, such as the Simoon,

the Helm, the Southerly Burster, the Föhn, the Sirocco, Khamsin, Harmattan, Solano, and others. Tornadoes, the relation between velocity and pressure, Beaufort's scale, Krakatoa, the Eiffel Tower, the distribution of seeds, waterspouts, showers of fish, fog, the distribution of small-pox, the sites of hospitals, and many other subjects, were dealt with in this able and comprehensive address, which of course will be printed *in extenso* in the Transactions of the Institute.

The only other strictly meteorological paper was by Surgeon-Major Black, who gave an interesting epitome of the results of observations of air and sea, made by him during several recent visits to the sea-side towns of Brighton, Folkestone, Hastings, Boulogne, and Havre. Dr. Black did not put forward his observations as other than those which any visitor could make, but his results are interesting, if not strictly comparable, and we do not remember having seen the question of sea-bathing in relation to the temperature of sea and of air so ably discussed before.

CONGRÈS INTERNATIONAL D'HYDROLOGIE ET DE CLIMATOLOGIE.

It is said that there were 68 Congresses held in Paris this year; there were certainly too many, and it may have been to that, to cold, wet weather, or to lateness in the year, that the woeful contrast between the Biarritz and the Paris Congress was due. Instead of the hundreds assembled at Biarritz, the total list of members (including Parisians, and in some cases the wives and daughter) up to Oct. 3rd was only 79, and at the sectional meetings an audience of half-a-dozen was unusually large. To some extent quality atoned for numbers, as the following list will show:—Antoine d'Abbadie, Bonkowski-Bey (*Constantinople*), Bouloumié (*Vittel*), Donaciano Morales (*Mexico*), Duhourcau (*Cauterets*), Durand Fardel, Faralli (*Florence*), Fines (*Perpignan*), Gandy (*Bagnères de Bigorre*), Labat, Lemoine, Leudet, Marcaillou d'Ayméric (*Aix*), Meunier (*Eaux Bonnes*), Poskin (*Brussels*), de Ranse, Renou, Rotch (*Blue Hill*), Schlemmer, Sénac Lagrange (*Cauterets*), de Valcourt (*Cannes*), Wada (*Japan*), Winternitz (*Vienna*).

It could, of course, not be otherwise than profitable to have the advantage of meeting men of such standing, but we are by no means sure that they would all feel gratified at contemplating the papers and discussions, good though some of them were.

The excursion to the Vosges was abandoned, the weather being unfavourable and late autumn having set in.

It was understood that the Italian delegates invited the Congress to assemble in Rome in 1892.

FINE METEOR DOUBLY OBSERVED.

To the Editor of the Meteorological Magazine.

SIR,—There was a magnificent meteor seen here on Monday, November the 4th, towards eight o'clock. I did not see it myself, but from the descriptions it must have been a fine sight. Many were startled by the sudden light shining on the ground, and looking up had just time to see the cause disappearing. My son was fortunate enough to see all its course for a long way across the sky.

Yours truly,

J. MATHISON.

Addington, Windsor.

To the Editor of the Meteorological Magazine.

SIR,—Did you see a very fine meteor at 7.55 p.m. on November 4th, in the N.W. at an altitude of 45°? The sky was completely overcast, so that no stars were visible; the light of the moon could be seen, but not its outline, and the meteor shone through the clouds like a small moon, and was followed by a very brilliant train or attendant meteor. Had the sky been clear, I think that it would have been magnificent.—Yours faithfully,

E. WHITE WALLIS.

49, Clifton Hill, St. John's Wood, N.W., 5th November, 1889.

A COLD PERIOD.*

To the Editor of the Meteorological Magazine.

SIR,—The fall in temperature which has taken place in parts of Europe suggests the question, has a similar fall taken place in the Southern Hemisphere? And as a contribution to the answer I send a diagram (*see frontispiece*) showing the mean temperature at Sydney, 1856 to 1888 inclusive, and the maximum and minimum for the same period. It will be seen that as far as Sydney is concerned the past four years have a mean 0°·3 above the average, and 1885 was the hottest year since 1867. Had the question been asked here in 1872, the answer would have been that the temperature had fallen steadily for the previous four years; if in 1878, that there had been a steady increase in temperature for the previous six years.†

Yours very truly,

H. C. RUSSELL, F.R.S.

Sydney Observatory, 26th August, 1887.

* See *Met. Mag.*, vol. xxiv., pp. 17 & 72.

† From 1856 to 1865 inclusive the exposure of the minimum was different from what it has been since, and the readings have been corrected to accord with those taken for the past twenty-three years, during which period thermometers have been exposed in the same shed.

REVIEWS.

Lehrbuch der Meteorologie für Studierende und zum gebrauch in der Praxis. Von DR. W. J. VAN BEBBER. 8vo., viii.—392 pages, 120 woodcuts, and 5 plates. Stuttgart : F. Enke, 1890.

WE protest against the custom of dating books wrongly, but as the bad example was, we believe, set by English publishers, it would be unfair to hold Herr Enke responsible, though he has dated an 1889 book 1890, and the evil will cure itself as the dates will soon become so unreliable as to pass without notice.

Taken altogether this is a very good book, and we cannot quote any English one similar to it. Of course, it is unequal ; meteorology is becoming too large a subject for anyone to be equally competent in all its branches. The author of the *Handbuch der Ausübenden Witterungskunde* is naturally strong upon synchronous observations and their application to weather forecasting, and his love of facts has led him to give a host of useful tables, many of them original, and the others judiciously selected. He is, however, too kind ; when he knows that people are doing wrong, he says nothing about it, shows that he knows it, but says nothing. For instance, on p. 125 he recognizes that the factor for Robinson's cups is considerably less than 3·0, and that therefore all published wind velocities are too great ; but he does not express any opinion upon the wisdom of continuing to publish figures which all well-informed persons know to be wrong. So also on pages 152 to 154 he shows that he is well aware that the force of wind increases with height above the ground, and yet he says nothing as to the absurdity of meteorological directors allowing architectural considerations to determine at what height their anemometers should be. As it is, there are hardly two anemometers in Europe fairly comparable. It is strange to observe how terribly weak Dr. van Bebbber is respecting instruments. His (Fig. 2), a Rutherford max. and min., such as was used in this country last century, would (as regards the max.) now and for thirty years past, have found its only proper place on a rubbish heap. We have not seen so bad an instrument at any station in France or England for at least 20 years. It is very curious to find such old-fashioned and defective apparatus engraved in the same book with some of Richard's best instruments, and in which other portions are of the highest character, and embody the results of the very latest researches, such as the chapters on "Cyclonic and Anti-Cyclonic Weather," and on "Weather Types." There is on the last page a funny illustration of the well-known tendency to make a second error if you try to correct one. On p. 234, the author (who does not often quote except from German sources) mentions twice Professor Osborne Reynolds as "Reynold" ; he has noticed this trivial error in the *Berichtigungen*, but says there that it should be "Reynholds."

We notice that of the numerical tables some begin the year with December, some with January. We hope that this merely arises from some being copied from older works. Surely Dr. van Bebbber

does not intend to oppose the decision of the various congresses ; if so, it will be for the official meteorologists who attended at Vienna, Rome, &c., to deal with the matter. We represent only the outside public, but on their behalf feel bound to protest against two sorts of year being used in one book.

In wie weit ist das heutige Klima Konstant. Von Prof. DR. E. BRÜCKNER. 8vo., 16 pages. Berlin ; D. Reimer, 1889.

THIS is a short paper, read before the German Geographical Society, on the very important subject of the variability of the earth's climate. It seems to us that the author rather changes the subject as he goes on. He seems to start with the idea of a change running during many centuries, quoting, *e.g.*, the prehistoric warm vegetation of the present Polar regions, and then drifts down to a discussion of a dry period occurring in some countries in 1856-60, in others 1861-65, and in others 1866-70. He tells us, however, that the large mass of data which he has collected will shortly be printed *in extenso*, and we therefore refrain from doing more than calling attention to the present paper and to the forthcoming book. We ought to mention that the author has not confined his researches to rainfall, but has studied the records of glaciers, of temperature, of the levels of lakes, of the freezing of rivers and of harbours, as well as those of the vintages, some of which go back hundreds of years. Dr. Brückner has set himself a Herculean task, and it will be to everybody's advantage if he can accomplish it.

Ergebnisse der Meteorologischen Beobachtungen im Systeme der Deutschen Seewarte, 1876-1885. Large 4to., 42 pages ; Hamburg, 1889.

Dr. Neumayer here gives us abstracts for the two lustra (1876-80 and 1881-85) as well as for the decade 1876-85 of the observations at nine coast stations in Northern Germany. The observations seem good, accurately reduced and printed, but we do not understand why the years begin with December. Surely that is not following the rules of the Vienna Congress. Why, even in this paper Dr. Neumayer says, "Nach den Beschlüssen des Wiener Kongresses beginnt das Beobachtung-Jahr mit dem 1 Januar."* and yet he, a member of the Vienna Congress, breaks its rules all through this book. Doubtless there is some explanation of this apparent contradiction, and we shall be happy to publish it if any one will tell us what it is.

The mean sea level pressures agree very closely, all being between 29.922 in. and 29.953 in. The mean temperatures range from 44°.3 at Memel to 47°·4 at Borkum ; the absolute max. was 93°·6 at Neufahrwasser, and the absolute minimum was -13°·5 at the same station, giving it therefore a range of 107°·1. The mean amount of cloud is generally between 6 and 7 on the usual scale of 0-10. The mean rainfall is least (18.47 in.) at Warnem-Wustrow and greatest (25.85 in.) at Keitum. Large daily falls are rare, but there is one case of 3.37 in. in 24 hours on June 17th, 1879, at Hamburg.

* According to the decision of the Vienna Congress, the observing year begins with the 1st of January.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	63·9	19	32·4	16	54·4	39·5	39·9	81	104·4	25·1	2·06	20	6·9
Malta.....	79·4	24	45·7	1	66·3	52·8	50·8	77	131·3	40·5	·42	2	3·8
Cape of Good Hope. ...	78·0	26	49·1	17	68·8	55·7	...	...	...	...	5·12	10	6·4
Mauritius.....	82·5	4, 7	69·4	15, 30	80·3	72·1	68·0	78	133·3	60·7	4·65	23	5·8
Calcutta.....	101·6	25	66·6	3	96·4	76·7	73·0	60	159·2	59·2	1·31	4	2·1
Bombay.....	91·4	15	72·0	10	88·1	77·3	74·0	75	146·8	63·0	·00	0	1·9
Ceylon, Colombo.....	93·0	3	74·3	29	89·5	76·6	73·5	78	151·0	72·0	15·18	23	5·6
Melbourne	87·9	2	37·2	28	69·7	52·1	51·1	72	136·2	29·5	3·60	7	6·1
Adelaide.....	82·5	30	49·6	7, 28	70·6	55·4	53·4	71	136·7	39·3	5·65	15	6·3
Wellington	70·0	4	40·0	14	63·4	49·0	47·7	73	123·0	31·0	1·32	7	3·6
Auckland	74·0	8	46·0	24	67·7	53·3	52·5	75	138·0	40·0	1·04	13	5·6
Jamaica, Kingston.....	92·9	28	69·6	23	89·0	72·9	71·4	71	...	...	·91	...	...
Trinidad	95·0	29	65·0	15	91·0	70·4	76·1	81	160·0	58·0	1·05	...	...
Toronto	67·3	24	25·5	1	51·7	34·9	34·1	68	...	19·8	1·59	11	5·8
New Brunswick, Fredericton	69·0	26	19·9	7	53·4	33·0	33·9	68	...	...	2·78	10	6·5
Manitoba, Winnipeg ...	79·2	25	13·0	3	54·9	28·7	30·3	65	...	...	·99	9	4·1
British Columbia, Victoria	66·0	7, 8	32·0	19	60·3	40·7	...	...	...	...	1·63	8	...

REMARKS, APRIL, 1889.

MALTA.—Mean temp. 58°·4; mean hourly velocity of wind 13·2 miles. The Sea temp. rose from 59°·8 to 62°·2. TS on 6th. J. SOULES.

Mauritius.—Mean temp. of air 0°·6, of dew point 0°·1, and R 0·67 in. below their respective averages. Mean hourly velocity of wind 12·0 miles, or 1·0 above average; extremes 25·8 on 14th and 2·0 on 29th. Prevailing winds E.S.E. and E.

C. MELDEBRUM, F.R.S.

COLOMBO. - Thunderstorms occurred on 17 days, and L was seen on 10 other days.

J. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air, 1°·8 of dew point 1°·7, mean amount of cloud 0·2, and R 1·37 in. above average; humidity same as average. Prevailing winds W. and N.; strong on 6 days. Heavy squalls from W. on 7th and 8th. Heavy dew on 14 days. L on the 2nd.

R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. 1°·4 below the average. The principal features of the month were the two heavy general rainfalls and floods on the 1st and 15th, which caused a great deal of damage, and resulted in loss of life by drowning. The total R for the past four months is the greatest for the same period since the foundation of the Colony.

C. TODD, F.R.S.

Wellington.—Generally fine weather, and a small R; showers in the middle and at the end of the month. Prevailing wind N.W., strong on 9 days. Slight earthquake on the 8th. Mean temp. 0°·8 below the average. R less than half the average.

R. B. GORE.

Auckland.—A fine and dry but cool month. Bar. pressure considerably above the average of 22 years. Mean temp. about 1° below the average. R not one-third of the average.

T. F. CHEESMAN.

TRINIDAD.—R ·85 in. below the average of 25 years.

H. C. HART.

SUPPLEMENTARY TABLE OF RAINFALL,
OCTOBER, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall	5·88	XI.	Castle Malgwyn	5·85
"	Margate, Birchington...	5·05	"	Rhayader, Nantgwillt..	7·28
"	Littlehampton	6·26	"	Carno, Tybrith	6·21
"	Hailsham	8·21	"	Corwen, Rhug	5·62
"	Ryde, Thornbrough	7·69	"	Port Madoc	4·93
"	Alton, Ashdell	5·09	"	I. of Man, Douglas	3·77
III.	Oxford, Magdalen Col...	2·36	XII.	Stoneykirk, Ardwell Ho.	4·29
"	Banbury, Bloxham	3·00	"	New Galloway, Glenlee	5·71
"	Northampton	3·07	"	Melrose, Abbey Gate...	4·79
"	Cambridge, Beech Ho...	...	XIII.	N. Esk Res. (Penicuik)	4·45
"	Wisbech, Bank House..	3·76	XIV.	Ballantrae, Glendrishaig	4·66
IV.	Southend	3·79	"	Glasgow, Queen's Park.	2·69
"	Harlow, Sheering	3·59	XV.	Islay, Gruinart School..	4·63
"	Rendlesham Hall	5·17	XVI.	Dollar	3·83
"	Diss	3·30	"	St. Andrews, Pilmour Cot	2·87
"	Swaffham	2·76	"	Balquhider, Stronvar..	6·11
V.	Salisbury, Alderbury...	3·74	"	Dunkeld, Inver Braan..	4·49
"	Warminster	3·67	"	Dalnaspidal H.R.S.	5·53
"	Bishop's Cannings	2·45	XVII.	Keith H.R.S.	2·61
"	Ashburton, Holne Vic...	7·35	"	Forres H.R.S.	2·39
"	Hatherleigh, Winsford.	3·61	XVIII.	Strome Ferry H.R.S...	3·81
"	Lynmouth, Glenthorne.	6·82	"	Fearn, Lower Pitkerrie.	2·93
"	Probus, Lamellyn	7·22	"	Loch Shiel, Glenaladale	5·56
"	Launceston, S. Petherwin	5·28	"	N. Uist, Loch Maddy	3·82
"	Wincanton, Stowell Rec.	4·66	"	Invergarry	2·91
"	Taunton, Lydeard Ho...	4·82	"	Loch Ness, Drumnadrochit	2·31
"	Wells, Westbury	3·92	XIX.	Lairg H.R.S.	1·00
VI.	Bristol, Clifton	2·26	"	Foranard H.R.S.	...
"	Ross	3·77	"	Watten H.R.S.	3·07
"	Wem, Clive Vicarage	3·54	XX.	Dunmanway, Coolkelure	6·10
"	Cheadle, The Heath Ho.	3·08	"	Fermoy, Gas Works	4·02
"	Worcester, Diglis Lock	2·70	"	Tipperary, Henry Street	4·06
"	Coventry, Coundon	2·61	"	Limerick, Kilcornan	2·91
VII.	Ketton Hall [Stamford]	3·24	"	Miltown Malbay	3·80
"	Grantham, Stainby	2·59	XXI.	Gorey, Courtown House	6·33
"	Horncastle, Bucknall	4·30	"	Navan, Balrath	4·41
"	Mansfield, St. John's St.	3·94	"	Mullingar, Belvedere	5·29
VIII.	Neston, Hinderton	2·91	"	Athlone, Twyford	4·59
"	Knutsford, Heathside	2·90	"	Longford, Currygrane	4·65
"	Lancaster, South Road.	4·99	XXII.	Galway, Queen's Coll...	4·00
"	Broughton-in-Furness	7·18	"	Clifden, Kylemore	7·02
IX.	Wakefield Prison	3·53	"	Crossmolina, Enniscoe.	7·23
"	Ripon, Mickley	4·14	"	Collooney, Markree Obs.	6·15
"	Scarborough, West Bank	5·13	"	Ballinamore, Lawderdale	4·63
"	East Layton [Darlington]	5·30	XXIII.	Warrenpoint	3·92
"	Middleton, Mickleton	4·89	"	Seaforde	3·88
X.	Haltwhistle, Unthank..	3·80	"	Belfast, New Barnaley	4·02
"	Shap, Copy Hill	7·05	"	Bushmills, Dundarave...	3·78
XI.	Llanfrecifia Grange	3·08	"	Stewartstown	3·08
"	Llandovery	5·31	"	Buncrana	5·81

OCTOBER, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				No. of High below 50°	No. of Low above 50°
		Total Fall.	Difference from average. 1870-9	Greatest Fall in 24 hours.		Max.		Min.					
				Dpth	Date			Deg	Date	Deg.	Date.		
		inches	inches.	in.								In shade.	On grass.
I.	London (Camden Square) ...	3·75	+ 1·05	·73	19	22	60·6	16	35·5	13	0	1	
II.	Maidstone (Hunton Court)...	5·09	+ 2·63	·75	10	21	...	...	...	...	...	...	...
	Strathfield Turgias	3·16	+ ·42	·44	20	23	60·3	2	30·1	14	5	10	
III.	Hitchin	3·41	+ 1·23	·69	19	23	57·0	7b	35·0	13	0	...	...
	Winslow (Addington)	3·10	+ ·48	·41	11	21	60·0	10c	30·0	14	2	5	
IV.	Bury St. Edmunds (Westley)	4·35	+ 2·32	·64	22	22	...	...	...	...	...	...	...
	Norwich (Cossey)	3·02	+ ·69	·50	16	17	...	...	...	...	...	...	...
V.	Weymouth (Langton Herring)	4·33	...	·52	18a	22	59·0	2d	39·0	13	0	...	...
"	Barnstable	5·59	+ ·14	·90	4	24	60·0	1e	...	...	...	...	...
"	Bodmin (Fore Street)	7·52	+ 1·30	1·56	18	26	...	...	...	...	...	...	...
VI.	Stroud (Upfield)	2·45	— ·56	·52	19	23	63·0	21	32·0	12g	2	...	...
"	Churchstretton (Woolstaston)	4·01	— ·59	·66	27	29	58·0	5	37·0	26	0	3	
"	Tenbury (Orleton)	3·21	— ·03	·61	27	25	61·2	17	30·0	14f	6	10	
VII.	Leicester (Barkby)	2·99	+ ·64	·41	27	27	60·0	2	29·0	13	4	9	
"	Boston	3·10	+ 1·07	·95	16	24	60·0	21	31·0	14	1	...	...
"	Hesley Hall (Tickhill)	2·99	...	·42	11i	25	59·0	14	30·0	11	4	...	...
VIII.	Manchester (Plymouth Grove)	3·11	— 1·25	·53	7	21	58·0	21	34·0	10	0	3	
IX.	Wetherby (Ribston Hall) ...	3·32	+ ·46	·56	12	19	...	...	...	...	...	...	...
"	Skipton (Arncliffe)	3·59	+ 1·33	1·72	22	22	59·0	1	37·0	5	0	...	...
"	Hull (People's Park)	3·97	+ 1·17	·78	16	24	...	...	...	...	...	...	...
X.	North Shields	4·40	+ 1·39	·80	12	24	58·0	6	36·0	11	0	0	
XI.	Borrowdale (Seathwaite)	13·77	— 2·78	2·43	6	21	...	...	...	...	...	...	...
"	Cardiff (Ely)	4·21	— 1·02	·62	19	23	...	...	...	...	...	...	...
"	Haverfordwest	4·75	— 1·70	·98	18	24	59·9	5	28·5	13	4	7	
"	Plinlimmon (Cwmsymlog) ...	7·94	...	1·22	4	21	...	...	...	...	...	...	...
"	Llandudno	3·36	— 1·23	·57	6	20	59·2	7	37·5	25	0	...	...
XII.	Cargen [Dumfries]	5·51	— ·20	·98	6	21	58·6	5	30·0	26	1	...	...
"	Jedburgh (Sunnyside)	4·74	+ 2·07	·67	12	26	55·0	11	33·0	14	0	...	...
XIV.	Old Cumnock	3·91	— 1·25	·97	6	20	58·0	16	23·0	25	10	...	...
XV.	Lochgilthead (Kilmory)	5·56	— 2·76	·95	6	16	...	...	...	...	...	...	...
"	Oban (Craigvarren)	5·24	...	·90	10	18	57·0	16	33·2	23	0	1	
"	Mull (Quinish)	5·26	...	·77	31	14	...	...	...	...	...	...	...
XVI.	Loch Leven Sluices	3·50	— ·81	·50	5	18	...	...	...	...	...	...	...
"	Dundee (Eastern Necropolis)	2·70	— ·47	·50	4	21	60·3	5	32·2	29	0	...	...
XVII.	Braemar	3·58	— ·90	·61	19	22	55·0	2	24·3	14	7	16	
"	Aberdeen (Cranford)	3·71	...	·58	17	25	60·0	11	30·0	28	4	...	...
XVIII.	Lochbroom	4·01	...	1·25	7	15	...	...	...	...	...	...	...
"	Culloden	2·36	+ ·07	...	...	...	55·0	6, 30	27·0	25	6	21	
XIX.	Dunrobin	3·12	...	·81	7	12	56·5	1	32·0	28	1	...	...
"	S. Ronaldsay (Roeberry)	3·38	— ·30	·49	9	20	53·0	5	40·0	25h	...	...	...
XX.	Cork (Blackrock)	3·68	— 1·06	·86	18	20	62·0	16	30·0	28	2	...	...
"	Dromore Castle	4·94	...	·84	6	21	67·0	1	30·0	23	...	...	...
"	Waterford (Brook Lodge) ...	5·05	...	2·06	18	24	61·0	2	30·0	14	2	...	...
"	O'Briensbridge (Ross)	2·96	...	·53	18	20	57·0	1, 2	32·0	25h	4	...	...
XXI.	Carlow (Browne's Hill)	5·77	+ 1·66	1·25	18	28	...	...	...	...	...	...	...
"	Dublin (Fitz William Square)	4·85	+ 1·43	·94	19	22	57·4	7	35·2	14	0	4	
XXII.	Ballinasloe	4·43	— ·00	1·12	18	23	54·0	15	28·0	23	8	...	...
XXIII.	Waringstown	3·52	— ·09	·64	4	25	60·0	2, 10	29·0	23	7	14	
"	Londonderry (Creggan Res.) ..	4·46	...	·87	6	23	...	...	...	...	...	...	...
"	Omagh (Edenfel)	4·42	+ ·10	·75	3	20	55·0	1, 2f	31·0	24	2	7	

a And 19. b And 8, 17. c And 15, 17. d And 7, 11, 15, 16. e And 16, 29. f And 15. g And 13.

h And 26, 27, 28. i And 27.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON OCTOBER, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—During the month the weather was changeable, with frequent R storms. On the whole the temp. was high and the atmosphere damp and muggy, with only a few days of fine weather with strong and drying winds.

ADDINGTON.—The month was characterised by frequent R, very little frost, and at times a very low barometer, particularly on the 7th, 9th, 19th, 20th, and 21st. Thunder on 3rd and 20th; heavy gale on 26th and 27th.

BURY ST. EDMUND'S, WESTLEY.—The total R for the month has been exceeded only four times in October since 1857. During a severe TS on the 3rd the church tower was struck by L and much injured.

LANGTON HERRING.—This was the wettest month since September, 1883, and the mean temp. was $0^{\circ}9$ below the average. L on the 11th.

WOOLSTASTON.—A pleasant autumn month, though there were only two days without rain. There was a severe gale on the 7th. Mean temp. $47^{\circ}1$.

ORLETON.—A cold, cloudy, damp, and rainy month, with a mean temp. about $2^{\circ}2$ below the average of 28 years, although the first 9 days were a little warmer than the average. The nights then became cold and frosty till the 15th, after which there was generally a cold, cloudy sky, with R every day, but not in large falls. Fogs occurred frequently. A solar halo was seen on the 14th and fine rainbows on the 17th, 19th, and 22nd. A storm passed over on the 8th, with some L and T, and distant T was heard on the 10th; on the 17th a strong gale blew. The bar. was generally low and unsteady during the latter half of the month.

LEICESTER, BARKBY.—An unusual number of days on which R fell, but no great bulk of R. T on the 3rd, 10th, and 20th; very few frosts. Swallow seen on 25th. Mean temp. $46^{\circ}2$.

MANCHESTER, PLYMOUTH GROVE.—During the month there were only about ten days of fine autumn weather, the remainder being wet, damp, and gloomy. Dense fog on the 11th and 17th. Mean temp. $47^{\circ}5$.

HULL.—With the exception of the 8th to 10th, 13th and 14th, 18th and 19th, and 29th to 31st, the weather during the month was wet, with frequent mists or fogs.

WALES.

HAVERFORDWEST.—There were a great many beautiful days for although R was recorded on so many, much of it fell at night. Temp. about the mean. Very stormy on the 7th. A fine frosty period occurred from 10th to 14th, followed by a week of very wet weather. Another frosty period occurred from the 23rd to 26th, and the month ended with damp and mildness.

SCOTLAND.

CARGEN.—A very wet and unsettled month. Mean temp. $46^{\circ}4$, or $1^{\circ}7$ below the average. Easterly winds prevailed for 19 days. Sunshine 20 hours less than the average. The beautiful appearance in the sky at sunrise showing bands of prismatic colours, as described in December, 1884, was seen on one or two mornings. T and L on 8th.

JEDBURGH.—A month of almost daily R. Trees shed their leaves with unusual rapidity.

MULL QUINISH.—A very fine month, excepting from 4th to 10th and the last three days.

LOCHBROOM.—A wonderful mixture of good, bad, and indifferent weather,

but there were many fine days and frosty nights. A very heavy storm with heavy E occurred on the 7th, followed by high floods, and the month closed with another great gale.

INVERNESS, CULLODEN.—The month was generally fine, little E falling after the 9th.

IRELAND.

CORK.—Fully two-thirds of the month was cool, cloudy and dark. A strong gale with heavy E blew on 17th and 18th, and there was much sheet L at night on the 21st. Temp. nearly two degrees below the average.

WATERFORD.—E '88 in. above the average. Mean temp. 47°·5. Swallows seen on the 15th, and starlings on the 20th. S.W. gale on 30th.

O'BRIANSBRIDGE, ROSS.—E nearly every day until 20th; then one week of fine bright weather, with slight frosts. A heavy gale blew from S.W. on the night of the 6th, uprooting large trees.

DUBLIN.—A cold, rainy, squally month, W. and S.W. winds prevailing at first, while E. and N.E. winds held from 18th to 29th. A gale of exceptional violence blew on the night of the 6th, the wind rising S.S.E. and subsequently veering to W. and W.N.W. There was another less destructive gale on the night of the 31st.

EDENFEL, OMAGH.—With the exception of the first two days and the fourth week—which were ideal autumn weather, clear dry and crisp—the month was persistently wet and unsettled, culminating on the nights of the 6th and 31st in gales of considerable violence; the former expended its greatest force to the south, and the latter to the north, of this station.

CLOUD PICTURES.

Many of our readers are aware that for years past Prof. Hildebrandsson, of Upsala, has devoted great attention to the study, the classification, and the photographic representation of clouds. Some years since he brought out a limited edition of a photographic atlas of clouds, which is still in great request. He is now about to issue a series of twelve chromolithographs reproducing oil paintings, of the principal forms of cloud, by Swedish and by German artists, and which paintings have been repeatedly retouched by the artists in consultation with Professors Hildebrandsson, Neumayer, and Köppen, and with Mr. Weilbach, of Copenhagen.

The chromolithographs will each be 12 inches by 9 inches (without reckoning the margin of the mounts); there will be twelve of them, and they will be accompanied by short explanations in French, German, and English.

As a grant in aid of the cost has been obtained, sets will be supplied by the publisher, G. W. Seitz, of Hamburg, at twelve shillings each set, or if 25 sets be ordered, at ten shillings per set.

We hope that for the credit of their country, for their personal pleasure, and for their instruction, several of our readers will treat themselves to a copy. They can either apply direct to the publisher, or, if they prefer it, we will do so, and may thereby save the 2s. per copy—though as there will be carriage to pay, the 2s. may dwindle to 1s., or become invisible.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCLXXXVII.] DECEMBER, 1889. [PRICE FOURPENCE,
[or 5s. per ann. post free.

THE DOUBLY OBSERVED METEOR OF NOV. 4TH, 1889.

THE SHEEP STAMPEDE OF NOVEMBER 3RD, 1888.

We adopt this double title for a reason which will be stated at the end of the following notes upon the meteor.

The meteor appears to have been observed at several places, one as far North as Corbridge-on-Tyne, 250 miles from London, where Mr. White Wallis saw it. We append all the accounts which we have been able to collect, they are not sufficient to fix its path accurately, but seem to indicate a first appearance over Gloucestershire at an elevation of about 50 miles, and a disappearance over Northamptonshire at a lower level. The following notes are arranged from S. to N :—

As to the meteor on the 4th inst., I was walking home that night in a N.W. direction, at a spot about $51^{\circ} 20\frac{1}{2}'$ N. and $0^{\circ} 35\frac{1}{2}'$ W. On the road I halted to notice a little to my right (looking about due north) a light in the sky, like a small moon with a following equally luminous "tail;" its direction was from left to right its highest limit I should say was about 45° , and it made a *slightly* descending arc of about 60° , commencing a *little* W. of N. This would be a few minutes before 8 o'clock. The atmosphere was thick and foggy, so that all brilliancy was lost—in fact the meteor was dull—the motion did not seem very rapid, but the diameter of the meteor appeared much larger than any I previously recollect to have seen; the fog no doubt to some extent caused this appearance.

Chobham, Woking.

HY. HORNCastle.

On Monday, November 4th, 1889, a brilliant meteor passed to the S.W. of Rose Hill, from W. or S.W. to E., as far as could be seen over the Berkshire Downs. Some few days after I saw an account in the *Standard* of a stampede of sheep on the Berkshire Downs. Had the meteor anything to do with it, or did it frighten them?—EDWARD COBB.

Rose Hill, Iffley, Oxon.

VOL. XXIV.

M

I saw the meteor on the 4th November ; the finest I ever saw. I thought that it was a vivid flash of lightning until I looked up and saw the object, I should say travelling from W. to E.—W. LUCAS.

Hitchin.

Yesterday evening, November 4th, at 7.55 p.m., I was fortunate enough to observe a very brilliant meteor. It became visible almost exactly at the zenith, or a little west of it, and moved, as nearly as I could judge, due east (magnetic) ; it remained visible for about from one to two seconds, disappearing finally, rather low down on the eastern horizon. For the first half of its journey it was of a dazzling white brightness, and then it suddenly became a dull red spark. The light emitted from it, when brightest reminded me of the light from an arc lamp, and was very much brighter than any of the fixed stars. As it was so short a time in view, and there were no stars visible, I could only approximately estimate its point of appearance and path. There were a few clouds about, mostly in the west, and the moon was behind them.—PAUL A. COBBOLD.

Warwick School, November 5th.

Was not the meteor seen from Warwick School on November 4th, the same as that mentioned in the following from my daughter, written from the school at Brookfield, Wigton, Cumberland.

"On Monday night (November 4th) at 7.55 p.m., when out on the playground viewing the stars, I saw a most beautiful meteor. It seemed to be very near, and was in sight for quite a long time. It appeared just over Skiddaw—that is to say, due South—and went towards the South East. It had a long tail of light, and burst, and sent out beautiful colours, and disappeared near the horizon."

Ackworth, Yorks, November 16th.

WM. SCARNELL LEAN.

November 4th.—About 8 p.m., a brilliant meteor as large and as bright as Venus, passed from W. to E. 10° or 15° above S. horizon, with a bright train of sparks behind it. Motion slow, apparently horizontal. Only seen for one or two seconds. Probably the meteor mentioned in the November number of the *Meteorological Magazine*.—JOHN COPPIN.

Bingfield, Corbridge-on-Tyne.

THE SHEEP STAMPEDE.

We come now, and with some satisfaction, to the question which was left unanswered last year—Why did so many hundred sheep in the South Midland Counties break out of their folds on the night of November 3rd, 1888. Readers who will turn to our numbers for November and December of 1888, will find the facts there, and they

will find that we then hinted at an explanation which now seems probable. On p. 154, at the foot of the first letter upon the subject we said, "It is curiously near the locality where the bolide of November 20th, 1887, is supposed to have burst." In our second article we did not further press the appearance of a meteor as an explanation, because there was no record of one having been seen. But we now go back to it because we have—

November 2nd, 1886.—Meteor bursting over North Cornwall.

November 20th, 1887.—Meteor bursting in the neighbourhood of Oxford.

November 3rd, 1888.—Unexplained panic among sheep in Oxford and Berks.

November 4th, 1889.—Meteor passing Gloucestershire to Northamptonshire, and stampede of sheep on Berkshire Downs. (See Mr. Cobb's note, *ante* p. 161.

ON THE BLACK BULB THERMOMETER IN VACUO,

BY PROF. HERBERT McLEOD, F.R.S.

[The following useful paper was read at the British Association Meeting at Newcastle. It was briefly mentioned in our last, but by the courtesy of Prof. McLeod we have now the pleasure of giving it *in extenso*.—ED.]

This instrument which is generally employed for measuring solar radiation does not appear to give universal satisfaction, for it is said that no two instruments give the same result when placed side by side. No doubt the imperfection of the vacuum may account for this in a great measure, but besides this there appear to be other causes.

When such an instrument is exposed to the rays of the sun, a large proportion of the radiation passes through the enclosing case, also traversing the opposite side of the globe. Some, however, is absorbed by the blackened thermometer bulb, and this then begins to radiate heat of low refrangibility which is incapable of passing through the enclosing case; as a consequence the latter becomes heated, so that the thermometer bulb is in a warmer enclosure than at first. The quantity of heat thus radiated will be diminished the smaller the bulb of the thermometer, and some years ago I suggested to Mr. Hicks to make a thermometer with a very small bulb; such a one was made, and I am informed that it gave readings ten degrees *higher* than any other instrument; as this was exactly opposite to my expectation, perhaps I may be excused for not attempting any explanation. Some months ago I ordered two instruments with very small bulbs, one to be in a thick case and the other in a thin one. When the instruments came I found that one of the bulbs which appeared the thicker was devitrified and rough, and produced a very

marked shadow when held before a screen exposed to sunshine, so I was not surprised to find that this thermometer always indicated a slightly lower temperature than the one with the clear glass; it was returned to the maker, and I was then informed that the bulb was a thin one, and the devitrification was caused by blowing the bulb before the lamp. These thermometers were in use from May 20th to June 6th, and the means of the readings of the thermometer with the thick case was 119.2, while the mean of the readings of the other instrument was 116.8. This, therefore, supported the theory that I had formed on the subject. I then had one of the thermometers enclosed in a case of very thick glass. The thermometers were then tested with a thermopile to determine the quantity of radiant heat that would pass through the enclosing cases. The source of heat was an alcoh-carbon flame, and the cases of the thermometers were interposed in succession between the flame and the cone of the thermopile.

Case of thermometer with large bulb transmitted... about 26 per cent. of the
Thin case of thermometer with small bulb..... „ 23 [radiant heat.
Thick case of thermometer with small bulb „ 11½ „ „

These thermometers were exposed to the sun's rays for the first 27 days of August, and the means of readings are as follows:—

Large bulb instrument	125°·7
Small bulb with thin case.. ..	119 °9
Small bulb with thick case	118 °3

Although the case of the instrument with the large bulb allowed a larger percentage of the rays from a low temperature source to pass through, yet the amount of heat radiated from the large bulb was so great that the case was warmed sufficiently to cause the instrument to read, on the average, nearly 6° F. higher than the small bulb instrument.

According to the theory enunciated above, the thermometer with the thick case should have read higher than the one with the thin case; it however, gave readings 1.6° F. lower, but it must be remembered that the thick case transmitted less than half as much of the radiation from the gas flame as passed through the thin case, so it must have stopped more of the radiation from the sun than the thin case, and notwithstanding this the temperature registered is very little less than that indicated by the other instrument.

The small bulb instrument has another advantage over the large bulb one inasmuch as it is much more sensitive, and so reaches the maximum more quickly than when a large bulb is used. This is shown by the readings on August 4th, when there were only some occasional gleams of sunshine, the large bulb registering 98.2° F., and the small bulb 101.8° F.

It seems to follow from these experiments that the black bulb should be as small as possible, have a dead black surface, and very little of the stem blackened; and also that the case should be as thin as is consistent with strength.

A series of experiments should be carried out with instruments of different sizes, and with cases of different thicknesses in order to set the matter at rest. Some investigations on this subject have been carried on at the Kew Observatory, but I believe they have been only partially published. An accident to our old instruments gave me the opportunity of having fresh ones constructed, and it seemed advisable to put the above results on record.

REVIEWS.

Étude sur la synthèse de la Repartition des Pressions à la surface du Globe. Par M. LEON TEISSERENC DE BORT. Paris : Gauthier-Villars, 1889. 4to, 23 pages and 4 double plates.

IN some of M. Teisserenc de Bort's earlier papers he has pointed out the relations between the distribution of air pressure and of air temperature—between isobars and isotherms. The present work is a step further in the same direction, but one which we despair of making clear to all our readers in much less space than the author has given to it, viz., the whole of three numbers of this magazine. We cannot do that, but we shall at the same time bring his work to the notice of experts in all parts of the world, and give our less advanced readers a general idea of its scope, by translating the author's own summary.

Summary.—We see then by this essay that the principal isobaric lines are explainable, and can be reproduced, by the following considerations :—

- (1). Originally the temperature of the whole atmosphere is assumed to have been equal at all parts of the earth's surface, decreasing gradually upwards, and its pressure on every part of the surface about 30 inches.
- (2). When the atmosphere had become sufficiently transparent for the heating effect of the sun to become sensible, a difference of temperature between the equator and the poles was produced, and hence resulted upper air currents from the equator towards the poles.
- (3). By virtue of the relative movement of the air due to inertia, the winds going towards the poles have a tendency to curve towards the E., and this tends to produce a gradient towards the poles. The surfaces of equal pressure thus approach the earth in proportion as the latitude increases, and more rapidly than the variation in density alone would produce. This prevents the principal barometric maxima occurring at the poles. There are thus formed in certain latitudes barometric maxima at places where the product of the height (comprised between the surfaces of

equal pressure of the higher regions and the earth), multiplied by the density of the air, is at its maximum. These maxima occur before reaching the Polar regions, because there the surfaces of equal pressure are too low. We find then between the equator and the poles, a sort of pad of air which is further increased by the retardation of the upper anti-trade, and the effects of the relative motion of the lower air which forms the trades and the west winds of middle latitudes.

- (4). In high latitudes the convergence of the meridians, by diminishing the breadth of the currents, compels them to increase their height, as their increase of velocity is rarely alone sufficient, hence the pressure becomes small between the middle and polar latitudes. These minima vary in their latitude according to variations in the gradients, and consequently in the velocity of the currents.
- (5). The differences in temperature which exist even in contiguous districts, and those also which in equal latitudes exist over land and sea, by changing the density of the lower strata of the atmosphere, destroy the regularity of the isobars, and lead to the formation between them of cyclonic and anti-cyclonic areas.

Thus are produced those grand centres of atmospheric action which give its true character to the general circulation of the atmosphere.

A WET TIME IN WEST AUSTRALIA.

We have been favoured with the following extract from a letter lately received, describing the exceptional winter of 1889 in West Australia :—

“Certainly the rainfall is most extraordinary, and is now beginning to be highly inconvenient. The squatters are wondering how and when they are going to get the wool off the sheep’s backs into London market, for it seems wool spoils and heats if shorn wet. and we have not had three consecutive fine days since May last, The hay and crops are splendid, but the grapes will be a failure as the blossom has been washed off the vines.

“A plague of caterpillars has also set in, attracted by the luxuriant vegetation.

“No living person has ever seen Australia so green as it now is, or the live stock so fat.

“It is *pouring* now, yesterday having been our only fine day for a week.”

Perth, Western Australia, October 23rd, 1889.

FLUCTUATION OF ANNUAL RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—In *British Rainfall* for 1886 you gave a table of the comparative rainfall for many years back, at the same time leaving spaces for three more years. Will you kindly inform your readers by what figure the rainfall for 1888 should be represented in the table? It does not seem to be explicitly stated in the last volume of *British Rainfall*. Perhaps 89 would be correct.

Yours faithfully,

G. VON. U. SEARLE.

30, Edith Road, West Kensington

[The calculations for the years 1882 to 86 are set out in full on p. 27 of *British Rainfall*, 1886, and we have pleasure in complying with Mr. Searle's request by giving the similar calculations for 1887 and 1888.—ED.]

		Chilgrove.	Nash Mills	Oxford.	Exeter.	Orleton.	Pode Hole	Boston.	Bolton.	Kendal.	Mean.
Mean.	1830-79...	33.61	26.82	23.40	30.33	30.00	25.57	22.66	47.39	51.48	—
Rain-fall.	{ 1887	25.31	20.44	18.98	22.18	21.07	15.13	14.67	27.92	32.37	—
	{ 1888	35.33	27.76	26.84	32.12	28.80	21.46	22.25	36.59	43.04	—
Ratios	{ 1887	75	76	81	73	70	59	65	59	63	69
	{ 1888	105	104	115	106	96	84	98	77	84	97

THE FLOATING ISLAND IN DERWENTWATER.

To the Editor of the Meteorological Magazine.

SIR,—With reference to the remarks by Prof. Meldola in your last number, I would call attention to the fact that at page 11, you state that the poles “could not resist the current setting northwards from the Lodore falls and from the Derwent,” so I have little doubt that these currents bring from these streams quantities of leaves, branches and brushwood, which get lodged partly underneath and partly against the island and its loose rooting. The island being anchored to the shore and bottom is prevented from being carried hither and thither as most floating islands are.

In hot summers the accumulated organic materials get more largely decomposed than at other times, and the gases evolved are carried by the current further underneath, and into the bowels of the island, so that when they accumulate enough to buoy up the island, it shows its top above the surface of the lake.

I do not think that without this reinforcement of decomposable matter, the island (*per se*) could have furnished sufficient material to insure upheaval for such a prolonged period.

Yours truly,

HENRY MUIRHEAD, M.D.

Cumbuslang, 21st November, 1889.

EXPLANATION BY DR. NEUMAYER.

To the Editor of the Meteorological Magazine.

SIR,—In your monthly Meteorological Journal for November of this year, you had, on page 155, the kindness to mention the recent publication of the Seewarte, "Ergebnisse der Meteorologischen Beobachtungen im Systeme der Deutschen Seewarte für die Lustren 1876-1880 and 1881-85, sowie das Decennium 1876-1885," and while giving due credit to the value of the observations and the publication generally, you criticised the mode of publishing the monthly results, placing December at the beginning of the series of the months for the year.

From the stipulations of the Vienna Congress it is evident that the mean values for the various meteorological elements should be compiled for periods from the 1st of January to the 31st of December, and for the single calendar months respectively. No special reference has been made to the single seasons of the year, leaving it to the option of the various directors to deal with them according to the means at disposal in each case. Stress must only be put on the fact, that the mean values are computed according to the stipulations of the Congress, and that the International scheme of publication is adhered to.

In explanation of the arrangement, placing the month of December first in the series instead of at the end of it, whereas the order is in other respects not disturbed, I may be allowed to refer to the fifth paragraph of the introductory remarks of the said work.

According to the explanation there given, the means for the period stated are to be invariably understood to be for the time from 1st of January 1876 to the 31st of December 1880, the 1st of January 1881 to the 31st of December 1885, and so on. The months of December invariably belong to the said respective periods for which the means are given, and the month of December was placed at the beginning merely for convenience sake, in order to have the winter months placed together in this series.

For climatological purposes it appeared to me advisable to adhere to the seasonal arrangement, if such could be carried out without offending the rules of the Congress, and without impairing the value of the work generally.

In the tables which contain the values for the single elements for the whole decennium in question 1876-1885, no reference was made to the single seasons, and to the mean values for them, in consequence of which, the order of the months was the usual one, and a comparison of the mean values in them, with those of the respective months in the tables of the single lustra, shows at a glance that they are identical and derived according to the same principle.

After this explanation I do not suppose that you still believe that in publishing these results I have transgressed the stipulations

of the Vienna Congress ; on the contrary, I have invariably been most anxious to adhere to them.

Yours very sincerely,

DR. G. NEUMAYER,

Hamburg, 30th November, 1889.

[We are always glad to be favoured with communications from meteorologists of such high standing as Dr. Neumayer, and we are especially glad that he has made it perfectly clear that he not only has not broken the rule of the Congress, but is a warm supporter of it. We had noticed the paragraph to which he refers, and were aware that the values were the proper ones. We thought that the Congress had gone further, and had advised that monthly values should always be printed in their normal sequence, but it is evident that there is no such rule, which we much regret. Nothing is more liable to lead to mistakes than having annual tables, some beginning with December and some with January.—ED.]

SALT HAIL.

To the Editor of the Meteorological Magazine.

SIR,—At page 137 Mr. Slatter says, "I allow that rain might be saline, but not hail." One day, six or seven years ago, a misty west wind blew against a window of mine, and deposited on it a thin crust, some of which I scraped off, and tasting found it salt. My niece also tasted, and agreed with me as to its saltiness. The nearest sea to my house is about twenty-five miles off, in the Firth of Clyde, above Greenock. If wind can carry salt moisture thus far, surely it may happen that in some cases it may be elevated enough to encounter circumstances that will transform the moisture into hail.

HENRY MUIRHEAD.

Cambuslang, 17th October, 1889.

A LUNAR RAINBOW.

To the Editor of the Meteorological Magazine.

SIR,—On the 9th instant my father and I were walking in the country about a couple of miles from Newquay, Cornwall, when we noticed a distinct lunar rainbow. The time was 7.15 p.m. and the rainbow was, as far as we could judge, due west. The sky was fairly clear, except for one very black cloud. It had just ceased raining when we observed the rainbow against the dark cloud. The moon was shining very brightly at the time. I did not notice for how long the rainbow was visible. My father did not observe any colour in the bow, but I fancy I did—faintly, but of this I am not quite sure.—Yours sincerely,

JNO. B. SNELL.

The Chestnuts, Oshidhurst, 12th October, 1889.

ROYAL METEOROLOGICAL SOCIETY.

THE first Meeting of this Society for the present Session was held on Wednesday evening, Nov. 20th, at the Institution of Civil Engineers; Dr. W. Marcet, F.R.S., President. in the chair.

Nine new Fellows were elected.

The following Papers were read :—

(1.) "Second Report of the Thunderstorm Committee." This is a discussion by Mr. Marriott on "The Distribution of Thunderstorms over England and Wales, 1871-1887," a period of 17 years prior to the appointment of the society's committee. The information used has been derived from various sources, the observers in communication with the Meteorological Office, Mr. Symons, and the Registrar General, and the Society's own climatological stations. By this means the average annual number of reporters for the 17 years was brought up to 143, and these were fairly distributed throughout the country. The stations were arranged according to the divisions adopted by the Registrar-General in the quarterly returns of births and deaths, but these divisions, 11 in number, are very unequal in area, Middlesex alone forming one division, while Herts, Buckingham, Oxford, Northampton, Huntingdon, Bedford, and Cambridge form another, and Monmouth and Wales make one division between them. The data have been tabulated for each month and year in the separate districts; 1880, 1882, 1884, and 1872 were the years of greatest frequency, and 1887, 1874, 1879, and 1871 those of least frequency, the most striking feature in the frequency diagram being the sea-saw nature of the curves, years of greater and less frequency alternating regularly throughout nearly the whole period. The Welsh division has the greatest number of thunderstorms in the month of August, but in the other 10 divisions, July is the month of maximum frequency. February and December have the least number in all localities. The average yearly number of storms for the 11 divisions is 39, the division comprising Surrey, Kent, Sussex, Hampshire, and Berks having the highest average 58.4, and Wilts, Dorset, Devon, Cornwall, and Somerset next highest with 52.3. Middlesex is lowest with 17.9 per annum, Cheshire and Lancashire next with 28.6, and Yorkshire third lowest with 32.7. The southern counties, therefore, are most liable to thunderstorms, and, curiously enough, the four northern counties, Durham, Northumberland, Cumberland, and Westmoreland, follow with 50.1 per annum. The report further shows the summer and winter distribution in each district, the order of maximum and minimum frequency agreeing very nearly with the annual.

(2.) On "The change of temperature which accompanies Thunderstorms in Southern England," by Mr. G. M. Whipple, B.Sc., F.R.Met.Soc.

(3.) "Note on the appearance of St. Elmo's Fire at Walton-on-the-Naze, September 3rd, 1889, by Mr. W. H. Dines, B.A., F.R.Met.Soc.

(4.) "Notes on Cirrus formation:" by Mr. H. Helm Clayton. The author, who has made a special study of cloud forms and their changes, gives a number of notes and drawings on the formation of cirrus under various conditions, *e.g.*, in a previously cloudless sky; cirrus bands with cross fibres; cirrus from cirro-cumulus clouds; cirrus drawn out from cumulus clouds; 'mares-tail' cirrus, &c. Curved cirrus clouds, when accompanied by decreasing barometric pressure frequently indicate that a storm of increasing energy is approaching.

(5.) "A comparison between the Jordan and the Campbell-Stokes Sunshine Recorder:" by Mr. F. C. Bayard, F.R.Met.Soc. As a result of a year's comparison between these two instruments, the author found that the Jordan Photographic recorder registered 30 per cent. more sunshine than the Campbell burning recorder.

(6.) "Sunshine:" by Mr. A. B. MacDowall. This is a discussion of the hours of sunshine recorded at the stations of the Royal Meteorological Society.

(7.) "On Climatological Observations at Ballyboley, co. Antrim:" by Prof. S. A. Hill, B.Sc., F.R.Met.Soc. This is the result of observations made during the five years 1884-88.

BERMUDA AS A STORM-WARNING STATION FOR THE ATLANTIC.

It is proposed that a meteorological station shall be established at the Bermuda Islands after the completion of the telegraph service between them and Nova Scotia. Many vessels leaving Halifax, the masters being unaware of the approach of storms from the West Indies, are dismantled before they have been out three days. The establishment of the proposed meteorological station would, therefore, be of great value, and the Canadian Government has willingly consented to bear half the cost.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MAY, 1889.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	81·2	24	42·7	2	66·2	49·3	49·5	79	125·9	32·8	3·22	14	6·3
Malta	85·4	26	54·2	5	71·7	59·0	56·7	79	136·3	48·4	·58	4	4·2
<i>Cape of Good Hope.</i> ...	81·8	13	44·0	9	65·9	52·1	...	...	...	...	5·35	12	7·8
<i>Mauritius</i>	80·6	2	60·0	25	78·1	66·3	64·7	79	129·6	52·0	1·51	13	4·4
Calcutta	101·8	2	70·4	22	94·9	79·2	77·9	74	161·2	68·9	3·53	8	3·4
Bombay	93·7	23	74·9	26	91·6	81·3	77·4	75	146·8	68·9	·67	1	3·2
Ceylon, Colombo	90·1	2	72·8	...	87·5	77·7	74·1	80	149·0	70·5	15·60	28	8·0
<i>Melbourne</i>	78·1	1	39·4	8	62·1	48·9	48·4	77	124·0	29·0	·94	11	6·5
<i>Adelaide</i>	75·5	1	37·5	26	63·7	50·3	48·9	74	134·9	29·6	4·09	14	5·8
<i>Wellington</i>	67·0	3, 5	36·0	18	59·3	46·6	45·3	76	135·0	26·0	·92	13	4·1
<i>Auckland</i>	68·0	7	42·5	18	62·3	51·3	49·7	74	124·0	35·0	5·41	17	6·8
Jamaica, Kingston	93·8	11	71·4	7	90·4	74·6	72·4	71	...	...	1·47	...	...
Trinidad	96·0	10	68·0	14	91·8	72·0	72·0	68	161·5	59·0	6·34	11	...
Toronto	80·8	18	30·7	29	63·2	44·6	45·5	70	...	22·5	3·14	15	6·5
New Brunswick, Fredericton	91·7	19	32·0	12	68·9	43·8	47·5	68	...	...	3·45	14	5·1
Manitoba, Winnipeg ...	81·1	6	19·3	1	64·9	34·1	36·1	61	...	...	1·72	11	5·2
British Columbia, Victoria	79·0	11	37·0	22	65·3	46·5	...	...	...	...	1·01	7	...

REMARKS, MAY, 1889.

MALTA.—Mean temp. $63^{\circ}6$; mean hourly velocity of wind 11·1 miles. Sea temp. rose from $60^{\circ}6$ to $70^{\circ}2$. TS on 25th. J. SCOLLES.

Mauritius.—Mean temp. of air $1^{\circ}0$ below, mean dew point $0^{\circ}4$ below, and E 3·06 in. below their respective averages. Mean hourly velocity of wind 6·9 miles, or 3·3 below the average; extremes 18·6 on 8th and $0^{\circ}0$ on 21st. Prevailing direction S.E. by E. to E.S.E. C. MELDRUM, F.R.S.

COLOMBO.—TSS occurred on 12 days; L was seen on 4 other days.

Melbourne.—Mean temp. of air $2^{\circ}4$, of dew point $2^{\circ}3$ above the average; humidity 1, cloud 0·1, and E 1·19 in. below average. Prevailing winds N. and S.E.; strong on 10 days. Heavy dews on 14 days; hoar frost on 2 days; fogs on 4 days. Hail on 13th and L on 2 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Pressure 0·47 in. above and temp. slightly below the average; E an inch in excess. Weather generally mild, with light showers but heavy general rains on 19th and 30th. C. TODD, F.R.S.

Wellington.—Fine up to the 9th, with N.W. winds, strong on 6th; from 10th to 19th light showers, with moderate S. winds. The remainder of the month generally fine, with winds from N.W. and S. towards the end. Fog on two days. Total E 3·49 in. below the average; temp. $0^{\circ}9$ above average. R. B. GORE.

Auckland.—A rainy, unsettled month, the E being quite $1^{\circ}25$ in. above the average. Mean temp. slightly below the average. T. F. CHEKESMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 NOVEMBER, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	1.24	XI.	Castle Malgwyn	3.21
"	Margate, Birchington...	.71	"	Rhayader, Nantgwillt..	2.62
"	Littlehampton	.77	"	Carno, Tybrith	2.46
"	Hailsham	1.30	"	Corwen, Rhug	2.04
"	Ryde, Thornbrough	1.75	"	Port Madoc	3.67
"	Alton, Ashdell	1.48	"	I. of Man, Douglas	2.67
III.	Oxford, Magdalen Col...	.88	XII.	Stoneykirk, Ardwell Ho.	1.94
"	Banbury, Bloxham	1.38	"	New Galloway, Glenlee	4.26
"	Northampton	.76	"	Melrose, Abbey Gate...	.82
"	Cambridge, Beech Ho...	1.17	XIII.	N. Esk Res. [Penicuik]	1.00
"	Wisbech, Bank House..	1.10	XIV.	Ballantrae, Glendrisaig	3.22
IV.	Southend	.84	"	Glasgow, Queen's Park.	1.75
"	Harlow, Sheering	.93	XV.	Islay, Gruinart School..	4.21
"	Rendlesham Hall	1.15	XVI.	Dollar.....	1.07
"	Diss	1.63	"	St. Andrews, PilmourCot	.70
"	Swaffham	1.43	"	Balquhiddier, Stronvar..	3.31
V.	Salisbury, Alderbury ...	1.12	"	Dunkeld, Inver Braan..	.95
"	Warminster	1.63	"	Dalnaspidal H.R.S. ...	2.99
"	Bishop's Cannings	1.10	XVII.	Keith H.R.S.	2.33
"	Ashburton, Holne Vic... 3.36		"	Forres H.R.S.	1.54
"	Hatherleigh, Winsford. 1.01		XVIII.	Strome Ferry H.R.S....	4.96
"	Lynmouth, Glenthorne. 1.85		"	Fearn, Lower Pitkerrie.	1.21
"	Probus, Lamellyn	3.71	"	Loch Shiel, Glenaladale	7.71
"	Launceston, S. Petherwin	2.27	"	N. Uist. Loch Maddy ...	3.12
"	Wincanton, Stowell Rec.	1.38	"	Invergarry	4.88
"	Taunton, Lydeard Ho... 1.30		"	Loch Ness, Drumnadrochit	2.89
"	Wells, Westbur, ...	1.89	XIX.	Lairg H.R.S.	2.21
VI.	Bristol, Clifton	1.22	"	Forsinard H.R.S.	...
"	Ross	1.09	"	Watten H.R.S.	1.71
"	Wem, Clive Vicarage ... 1.23		XX.	Dunmanway, Coolkelure	5.63
"	Cheadle, The Heath Ho. 1.25		"	Fermoy, Gas Works ...	2.12
"	Worcester, Diglis Lock .98		"	Tipperary, Henry Street	2.12
"	Coventry, Coundon 1.18		"	Limerick, Kilcornan ...	2.07
VII.	Ketton Hall [Stamford] .76		"	Miltown Malbay.....	3.62
"	Grantham, Stainby	.52	XXI.	Gorey, Courtown House	1.25
"	Horncastle, Bucknall 65		"	Navan, Balrath	1.56
"	Mansfield, St. John's St. .69		"	Mullingar, Belvedere...	1.69
VIII.	Neston, Hinderton	2.66	"	Athlone, Twyford	1.68
"	Knutsford, Heathside ... 2.35		"	Longford, Currygrane...	2.05
"	Lancaster, South Road. 2.29		XXII.	Galway, Queen's Coll... 1.77	
"	Broughton-in-Furness .. 3.51		"	Clifden, Kylemore	6.49
IX.	Wakefield Prison	.83	"	Crossmolina, Enniscoe..	2.22
"	Ripon, Mickley	.79	"	Collooney, Markree Obs.	2.54
"	Scarborough, WestBank	2.20	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington] 1.05		XXIII.	Warrenpoint	1.82
"	Middleton, Mickleton.. 1.26		"	Seaforde	1.47
X.	Haltwhistle, Unthank.. 1.21		"	Belfast, New Barnsley..	2.26
"	Shap, Copy Hill	2.78	"	Bushmills, Dundarave...	2.57
XI.	Llanfrechfa Grange	1.67	"	Stewartstown	2.13
"	Llandoverly	2.52	"	Buncrana	1.98

NOVEMBER, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which 40 or more fell.	TEMPERATURE				No. of Nights below 32°
		Total Fall.	Differ- ence from average. 1870-9	Greatest Fall in 24 hours.		Days on which 40 or more fell.	Max.		Min.				
				Dpth.	Date.		Deg.		Date.	Deg.	Date.		
		Inches	Inches.	in.									In shade. In prism. On grass.
I.	London (Camden Square) ...	.89	— 1.55	.38	24	8	60.3	8	27.8	28	410		
II.	Maidstone (Hunton Court)...	.89	— 2.01	.38	23	7	...	...	...	...	...		
	Strathfield Turgiss	.64	— 2.11	.36	24	8	59.3	15	26.2	29	712		
III.	Hitchin	.97	— 1.64	.39	3	10	55.0	8, 9	27.0	27f	6...		
	Winslow (Addington)	1.00	— 1.50	.40	24	8	57.0	8	25.0	29	710		
IV.	Bury St. Edmunds (Westley)	1.64	— 1.10	.45	3	9	...	...	...	...	...		
	Norwich (Cossey)	1.51	— 1.80	.40	27	9	...	...	26.0	13a	110		
V.	Weymouth (Langton Herring)	1.48	...	.41	24	10	58.0	15d	28.0	28	3...		
"	Barnstaple	2.81	— 1.34	.53	2	15	59.0	23	28.0	29	...		
	Bodmin (Fore Street)	3.30	— 2.03	.82	24	20	...	...	...	...	...		
VI.	Stroud (Upfield)	1.12	— 1.82	.44	24	8	58.0	8	24.0	27	7...		
"	Church Stretton (Woolstaston)	1.35	— 2.09	.37	22	12	58.5	8	27.0	28	4, 9		
	Tenbury (Orleton)	1.02	— 1.84	.29	24	11	62.0	7	25.2	29	6, 9		
VII.	Leicester (Barkby)	.86	— 1.47	.20	24	13	59.0	8	20.0	23	916		
"	Boston	.59	— 1.78	.30	27	7	65.0	10	23.0	29	7...		
	Hesley Hall (Tickhill)	.41	...	.08	2a	12	63.0	7	27.0	28	7...		
VIII.	Manchester (Plymouth Grove)	1.89	— 1.19	.40	14	16	61.0	7	28.0	26g	5, 8		
IX.	Wetherby (Ribston Hall) ...	.67	— 2.09	.36	15	7	...	...	...	...	...		
"	Skipton (Arncliffe)	2.39	— 3.36	.56	1	14	56.0	9	24.0	27	9...		
"	Hull (People's Park)	.56	— 2.61	.10	24b	13	...	...	...	...	...		
X.	North Shields	1.02	— 2.43	.29	14	10	61.0	7	25.5	27	910		
	Borrowdale (Seathwaite)	6.82	— 5.00	1.15	24	17	...	...	...	...	...		
XI.	Cardiff (Ely)	2.12	— 2.08	.76	23	12	...	...	...	...	...		
"	Haverfordwest	3.34	— 2.00	.81	2	21	56.0	6	28.3	28	4, 7		
"	Plinlimmon (Cwmsymlog) ...	3.43	...	1.02	24	14	...	...	...	...	...		
	Llandudno	1.38	— 2.53	.77	22	15	62.0	22	33.8	27	0...		
XII.	Cargen [Dumfries]	2.06	— 1.85	.66	1	13	58.6	10	22.6	27h	7...		
	Jedburgh (Sunnyside)	.64	— 2.37	.14	21	7	60.0	10	26.0	27	8...		
XIV.	Old Cumnock	3.75	+ .28	1.16	1	18	56.0	7	...	...	6...		
XV.	Lochgilphedra (Kilmory) ...	4.09	— 1.27	.70	1	21	...	...	...	...	...		
"	Oban (Craigvarren)	3.26	...	.62	24	25	54.8	7	30.0	27	2...		
"	Mull (Quinish)	4.78	...	1.18	30	21	...	...	...	...	...		
XVI.	Loch Leven Sluices	1.10	— 2.45	.30	5c	7	...	...	...	...	...		
	Dundee (Eastern Necropolis)	.70	— 2.43	.35	22	6	60.9	10	23.9	26	6...		
XVII.	Braemar	2.28	— 1.49	1.33	1	12	59.8	9	25.3	26	1119		
	Aberdeen (Cranford) ...	1.08	...	.22	24	14	62.0	7	29.0	26	7...		
XVIII.	Lochbroom	6.81	...	2.75	1	19	...	...	...	...	...		
"	Culloden	1.86	— .84	...	...	...	58.0	7	28.0	26i	318		
XIX.	Dunrobin	2.10	...	.54	1	11	60.2	9	27.0	27	7...		
	S. Ronaldsay (Roeberry)	1.92	— 2.16	.37	1	20	54.0	6	17.0	27	3...		
XX.	Cork (Blackrock)	2.49	— 2.12	.56	24	16	60.0	8	27.0	28	3, 5		
"	Dromore Castle	4.13	...	.75	24	17	69.0	17	30.0	28	...		
"	Waterford (Brook Lodge) ...	1.92	...	.49	24	15	55.5	8	24.0	29	5...		
"	O'Briensbridge (Ross)	2.30	...	.73	24	19	58.0	12e	30.0	28	1...		
XXI.	Carlow (Browne's Hill) ...	1.83	— 1.09	.57	22	18	...	...	...	...	...		
	Dublin (Fitz William Square)	.93	— 1.35	.36	22	9	59.7	7	29.6	28	211		
XXII.	Ballinasloe	1.55	— 1.45	.47	24	16	54.0	8	26.0	27h	8...		
XXIII.	Waringstown	2.18	— .53	.36	17	18	57.0	7, 18	26.0	27	712		
"	Londonderry (Creggan Res.)	2.77	...	.58	26	19	...	...	...	...	...		
"	Omagh (Edenfel)	2.00	— 1.05	.50	26	18	55.0	7	26.0	28	4, 8		

a And 14. b And 26, 27. c And 23. d And 16. e And 13, 14. f And 30. g And 27.

h And 28. i And 27, 28.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON NOVEMBER, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRAATHFIELD TURGISS.—The weather has been unusually open and mild, and fogs have been rare. Roses are still in bloom out of doors, the hawthorn has bloomed again, cherry trees are full of bud, and poppies and the yellow rag-wort (*Senecio Jacobæa*) in full flower. Violets and primroses are in flower in gardens. Bar. exceedingly high on 19th (30·652); 23rd, anti-cyclone giving way and a gale from S.W. to N.W. Close of the month very cold and wintery.

HITCHIN.—A very dry month; highest bar. since January.

ADDINGTON.—One of the driest Novembers since 1871, twice only a less quantity registered, viz.: 1871 (0·87 in.), 1879 (0·76 in.) It was also unusually mild until quite the end, the 27th being the first really cold day, with a max. temp. of 35°. Bar. high during the month, particularly from 17th to 21st.

BURY ST. EDMUND'S, WESTLEY.—The month was mild and foggy till the 25th. Deep snow on the 27th, and cold for the time of year till end of month.

WEYMOUTH, LANTON HERBING.—On the whole a very fine, mild month. The small amount of R for this month has increased the deficit for the eleven months to 23 per cent. Mean temp. 2°·6 above the average; mean min. 2°·3 above the average. There were several foggy days; on the 24th very stormy.

WOOLSTASTON.—The early part of the month was warm and sunny, the 8th being quite a summer's day. The last ten days were very cold, S falling on 25th and 26th. Mean temp. 43°·7.

ORLETON.—The weather was generally cloudy, dull, and warm, and frequently foggy, with only two frosty mornings till the 25th. The bar. was very high and steady till the 24th, when a sudden decrease of pressure took place, followed by a strong gale of wind and a low temperature till the end of the month. The mean temp. of the whole month was 2°·2 above the average of the last 28 years. R much less than the mean of the month. A light fall of S occurred early in the morning of the 27th; a solar halo on the 5th. Wind generally light till the 24th, but afterwards strong and cold.

LEICESTER, BARKBY.—The first S fell on the 26th. Mean temp. 42°·1, mean max. 48°·6, mean min. 35°·5.

MANCHESTER, PLYMOUTH GROVE.—The first three weeks the weather was mild, damp, and foggy; no dense fog during the month. A fall of S on the 26th. Last five days wintery weather and very cold.

HULL.—The weather during the month was generally fine, sometimes with fog and with a little frost and S towards the end.

WALES.

HAVERFORDWEST.—Mildness, with constant R, characterised the first week; the first two days very stormy with T and L, followed by a sharp frost at night on the 4th; shade temp. 30°·5. Mild, but generally gloomy weather generally characterised the month until the 20th, when the weather began to get cold and wet. The 26th was very cold and gloomy, with a strong easterly current of air, followed on the 27th by a heavy snowstorm, S falling to the depth of 7 in. over the whole of the Precelly range, and remaining more or less to the end of the month.

SCOTLAND.

CARGEN.—A calm, foggy month generally. Sunshine (68 hours) considerably below the average; mean temp. of the month ($43^{\circ}\cdot7$) $2^{\circ}\cdot2$ above the average; mean bar. pressure (30·080 in.) a quarter of an inch above the average; for five days (16th to 20th inclusive) the pressure ranged from 30·548 in. to 30·590 in.

JEDBURGH.—Up to the beginning of the last week the mildness has been most unusual for the season. Primroses are in full bloom, wallflowers, &c. The frost of last week has been beneficial, as it has checked the growth of root crops.

OBAN, CRAIGVARREN.—A very general R, though less than the normal amount for the month. Growth continued throughout. A little S fell at the close, with a cold spell of weather.

ABERDEEN, CRANFORD.—Blinding snow showers on evening of 23rd; snow on the ground averaged 3 in. deep on the morning of 24th.

LOCHBROOM.—The month began with as two stormy and rainy days as ever remembered—the heaviest R for years, and ended with a very stormy and wintry week, but the rest of the month was summer-like.

INVERNESS, CULLODEN.—The weather throughout particularly fine. Temp high, and from the 1st to the 17th and 18th no R fell. Some sunsets very beautiful.

ROEBERRY.—Very fine until 24th, afterwards coarse and unsettled. S on 26th, T on 29th.

IRELAND.

CORK.—Changeable and humid, and at times foggy, with a steady high bar.

WATERFORD.—Mean temp. $46^{\circ}\cdot2$; average R for the month 3·73 in., the fall was therefore 1·81 in. below the average; hail on the 26th, aurora on the 27th, lunar rainbow on the 29th.

O'BRIANSBRIDGE, ROSS.—A very mild month. Thermometer fell to or below frost only on one night. Dense fog on the 23rd.

DUBLIN.—The month was calm, dull, and comparatively mild and rainless—a contrast to November of last year, which was the wettest and most stormy November experienced in Dublin for 25 years. At the close of the month a spell of wintry weather was experienced. Mean temp. above the average. A lunar halo on the 4th, a solar halo on the 14th; high winds on 5 days; gale on the 1st; more or less foggy on 9 days. L on 25th; hail on the 1st; sleet and snow 26th and 27th. An aurora borealis was seen on the night of the 26th. At the beginning of the last week a sudden change from autumn to winter.

OMAGH, EDENFEL.—The month commenced with gales and rain, but from the 3rd to the 21st there followed a period of abnormal mildness, calmness, and humidity—stagnancy would better describe its condition—with an atmospheric saturation evidenced by an almost daily measurable quantity in the gauge. Many shrubs and plants burst into leaf and flower for the second time, and the song of the non-migratory song-birds was quite general. The fourth week, however, was a rude awakening and was winter pure and simple, with an average of six inches of S and steady night frosts.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXVIII.] JANUARY, 1890. [PRICE FOURPENCE,
or 5s. per ann. post free.

THE EIFFEL TOWER AND ITS USE.

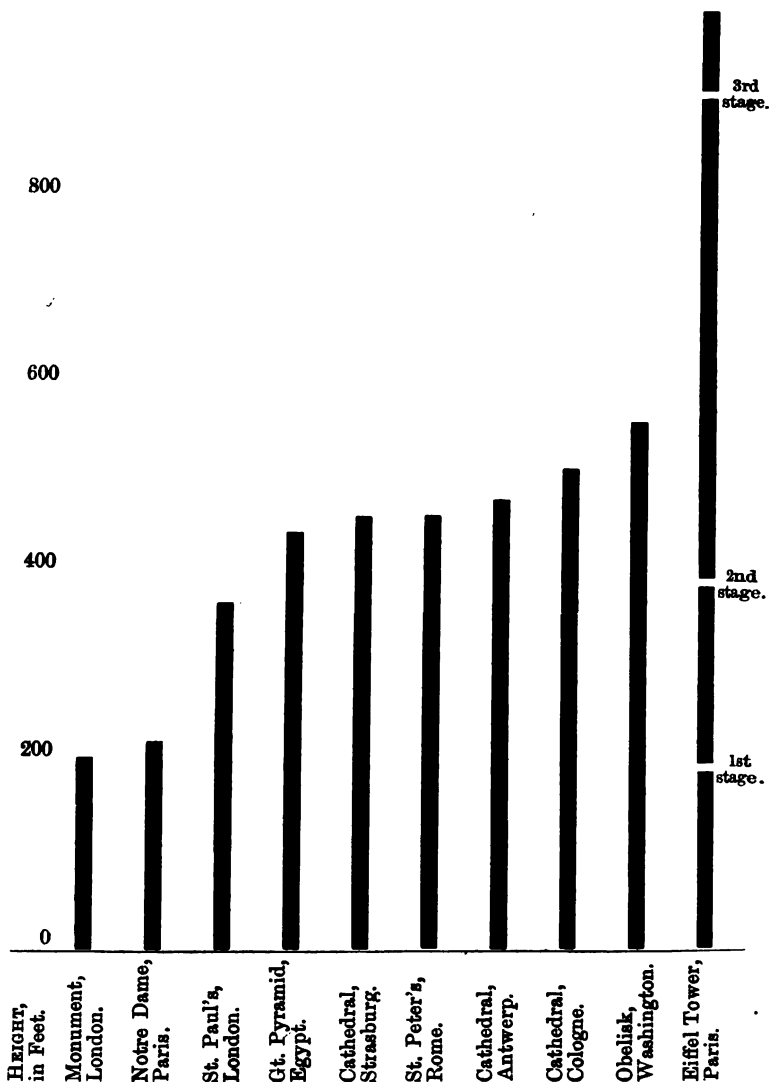
WE did think of giving a sketch of the Eiffel tower in illustration of the following remarks, but we found that to represent the meteorological apparatus even on the smallest scale visible without a magnifier, our view of the tower must be eight feet long, so we gave up the idea.

Almost everybody has either seen the tower or an engraving of it, and almost everybody admits its elegance and the skill shown in its design. It would be interesting to disinter from the press of 1886, a list of the authorities in the "world of light and leading," who then proclaimed the proposal as a mistake, an abomination—a disgrace to Paris, &c. But they are silent now; the tower was built, the world went and saw it, and thought and talked more about it, than about all the other wonders in the monster show.

A company has been formed to erect a somewhat similar tower in the metropolis, and it has received almost as many sneers and as much ridicule as did M. Eiffel's. Perhaps those sneers may be regarded as an augury for good. There are many respects in which a lofty tower might be of enormous utility in London—we mention only two subjects, fires, fogs.

Here we have to deal with M. Eiffel's tower solely from a meteorological standpoint—but before going into that branch of the subject we have prepared a diagram giving approximately the relative heights of some of the loftiest buildings in the world. We do not, however, vouch for the correctness of the heights, because we can find no two tables which agree—*e.g.*, in some cases the height is reckoned above the floor of the *crypt*—and there is a tradition that the 404 feet sometimes attributed to St. Paul's Cathedral, is the height of the cross above the Thames!

APPROXIMATE HEIGHT OF LOFTY BUILDINGS.



The public were taken by the lifts up to the 3rd Floor, at the height of 896 ft., but the tower reaches more than 80 ft. above that, and terminates with an iron floor about 4 ft. in diameter,

surrounded by a breast high iron railing, to which are attached a series of meteorological instruments—all supplied by Messrs. Richard Frères. We are not sure that we remember them all, but from memory we give the list as follows :—

Anemometers recording direction, velocity and inclination of wind—thermometer screen with max. min. dry and wet thermometers—recording thermograph, hygrometer and rain gauge—many of these instruments recorded their indications at the ground level, telegraph wires carrying the indications to MM. Richard's case in the *Palais des arts libéraux*. From near the centre of this little platform rose the lightning conductor, and above all (even above the rain gauge !) floated the national flag.

THE TOWER STRUCK BY LIGHTNING.

A very ridiculous idea took possession of some Parisians, they thought that there were more thunderstorms than usual, and declared that the Eiffel Tower produced them. If it had any effect it would probably be to dissipate, rather than to create, storms. But one day it was announced that the tower had been struck by lightning. As it is probably the best lightning conductor in the world, there was no reason why it should not be struck, but strong reason why it should be none the worse for it—and that is what proved to be the case, as is shown by the following account :—

As many exaggerated reports have been circulated concerning the effects of the flash of lightning which struck the Eiffel Tower on the evening of the 19th of August, M. Mascart has drawn up a report upon the phenomenon, which was observed amongst others by M. Foussat, the chief of the electric service, who happened to be on the upper platform of the tower at the time.

The tower is protected by a central rod at the summit and by eight other rods on the balustrade of the third platform. The discharge of lightning occurred at 9.40 p.m. and struck the principal conductor at the summit ; it was accompanied by a terrific noise, resembling the detonation of several pieces of artillery. Some red metallic droplets, were detached from the point of the conductor, and were probably due to the combustion of particles of volatilised iron. The lightning-conductors on the platform appeared to have luminous "brushes" at their points, and a considerable decrepitation was noticed. The official who looks after the light was near his apparatus and two men were at work with the machinery, while M. Foussat was leaning against the balustrade, and it is remarkable that neither of these four persons experienced the least inconvenience at the time of the flash, neither were any of the meteorological instruments damaged.

Almost immediately after the tower was struck, a strongly-electrified cloud (it was raining at the time) surrounded the lantern of the tower, and, no doubt, this circumstance gave rise to the impression, which many observers at some distance from Paris

experienced—namely, that the upper part of the Eiffel Tower, immediately after the discharge, appeared to be enveloped in a *luminous* electric cloud, which almost entirely eclipsed the light from the lantern.

M. Mascart considers that there was nothing very extraordinary connected with the phenomenon; that it has conclusively proved that the tower has perfect communication with the earth, and that the safety of the edifice has been definitely established.

THE ANEMOMETER ON THE EIFFEL TOWER.

The *Comptes rendus* of the Paris Academy of Sciences, of Nov. 4th, 1889, contains a note by M. A. Angot, on the mean hourly velocity of the wind at the summit of the Eiffel Tower, measured during 101 days ending with October 1st, by means of an Anemometer placed at 994 feet above the ground, and compared with the results of a similar instrument at the Paris Meteorological Office, placed at 66 feet above the ground. The average velocity on the tower was 16 miles an hour, being over three times the amount registered at the Meteorological Office, where it was only 5 miles an hour. At the lower station the diurnal variation showed a single minimum about sunrise, and a single maximum about 1 p.m. On the tower the minimum occurred about 10 a.m., and the maximum about 11 p.m., while the characteristic maximum of lower regions about the middle of the day was hardly perceptible on the tower. It is remarkable that this inversion, which is usual upon high mountains, should occur at so small a height as that of the Eiffel Tower. The ratio of increased velocity was constant at about 5·1 between midnight and 5 a.m.; it then decreased rapidly and became 2·1 at about 10 a.m., and maintained this value until 2 or 3 p.m., when it again rose regularly until midnight.

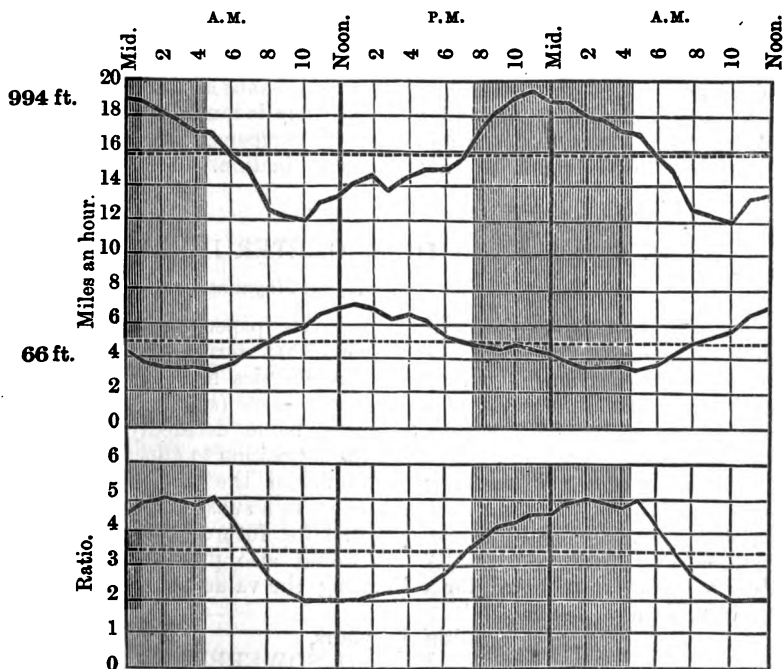
We append the table given by M. Angot, but have converted the wind velocities from metres per second into the equivalent in miles per hour.

Mean Velocity of the Wind upon 101 days between June 18th and September 30th, 1889.

Hour.	Eiffel Tower.	Bureau Central.	RATIO.	Hour.	Eiffel Tower.	Bureau Central.	RATIO.
Midnight...	19·0	4·1	4·6	Noon	13·5	6·9	2·0
1 a.m. ...	18·8	3·9	4·9	1 p.m. ...	14·2	7·1	2·0
2 " ...	18·1	3·6	5·0	2 " ...	14·4	6·9	2·1
3 " ...	17·8	3·6	4·9	3 " ...	13·9	6·3	2·2
4 " ...	17·2	3·6	4·8	4 " ...	14·4	6·4	2·3
5 " ...	16·7	3·4	5·0	5 " ...	15·0	6·2	2·4
6 " ...	15·8	3·7	4·3	6 " ...	15·1	5·5	2·7
7 " ...	14·7	4·2	3·5	7 " ...	15·6	4·7	3·3
8 " ...	12·5	4·7	2·7	8 " ...	17·3	4·5	3·8
9 " ...	12·2	5·4	2·3	9 " ...	18·2	4·4	4·1
10 " ...	12·0	5·9	2·0	10 " ...	19·2	4·6	4·2
11 " ...	13·3	6·5	2·0	11 " ...	19·6	4·4	4·5

We always hold that diagrams form far the best mode of communicating facts, and the above results are so unexpected that we have tried to make them quite clear. It will be seen that M. Angot's discussion referred to the period between the middle of June and the end of September—for this period sunrise may be roughly taken as about 5 a.m. and sunset as 7 p.m., and in the diagram, shaded space represents the time when the sun was below the horizon—shade = night, white = day.

The diagram represents the average velocity of the wind at the two positions for the 101 days, and it has a further peculiarity, which when understood is a convenience, but unless understood is perplexing—the diagram contains 36 hours—i.e., *the morning hours are repeated after midnight*. This enables one to study the general character of any part of the curve much better than if the night had been given only in two disjointed halves. When one wishes to study the daylight phenomena, one can cover the 3rd 12 hours; when to study those of the night, the 1st 12 hours.



At the Bureau Central, at 66 ft., scarcely a $\frac{1}{4}$ of a mile from the base of the tower, the wind velocity shows the same law as is found at the majority of European observatories, namely, a maximum

velocity shortly after noon and a minimum just before sunrise, the one being double the other.

On the tower the wind is, on the average, much stronger than down below, which is of course readily explained by the absence of retardation by friction against trees and buildings; but what is not easily explained is the further fact that the time of maximum and of minimum are almost reversed—the max. occurring about midnight and the min. about 10 a.m. The sharpness of the effect of sunrise on the winds motion is apparent in all three curves, but especially in the lowest one, which gives the ratio of the velocity at 994 ft. to that at 66 ft. During the night the wind was generally five times as strong as below, but no sooner does the sun rise than the ratio falls rapidly until during the heat of the day it is only twice, and then as the sun declines it rises gradually to its former point of 5 to 1, the average being rather more than three to one.

The Eiffel tower has much yet to teach us, but, besides having in its construction afforded work to thousands, pleasure to the tens of thousands who ascended it, and considerable profit to the builders, it will, we believe, keep off serious accidents from lightning from about 70 acres of Paris; it has already taught us much as to the nature and causes of wind velocities, with perhaps an indirect hint as to factory chimnies, and we know that there is much yet to come with respect to temperature and other phenomena. So much for what we were told would be “a useless abomination.”

ON THE BLACK BULB THERMOMETER IN VACUO.

To the Editor of the Meteorological Magazine.

SIR,—In reading Prof. McLeod's valuable paper on the black bulb thermometer in vacuo, I was somewhat surprised that one so evidently conversant with work in Physics had omitted all mention of the dimensions of his thermometers (small and large even in the matter of thermometer bulbs, being decidedly vague). I should be obliged if you would allow the suggestion to appear. That the insertion of the diameters of the bulbs of the thermometers, and also of the bulbs of the vacuum jackets in a subsequent issue of the *Met. Mag.* would add necessary detail for future experimenters in using Prof. McLeod's results. It would also provide ordinary observers with a standard for estimating the value of their own black bulb thermometers.

Faithfully yours,

H. SOWERBY WALLIS.

25, Northwood-road, Highgate,
December 20, 1889.

Stephen Joseph Perry.

ALTHOUGH astronomers are disappointed with the results of the expeditions to observe the last total solar eclipse, that which has most saddened both them and meteorologists is the loss away in British Guiana, of Father Perry, a man respected, and we think we may say loved by all who knew him. Our only hesitation on that point being produced by the remembrance of the action of the Meteorological Council towards the observatory which Perry ably and carefully directed for nearly 30 years.

The obituary notice in the *Times*, though brief, was so much to the point that we reprint it.

Stephen Joseph Perry was born in London in 1833, and, after studying at the Catholic colleges of Douay and Rome, entered the Society of Jesus in 1853. Between this latter date and 1860, he went through a special course of mathematics at Paris, and was appointed professor and director of the observatory at Stonyhurst College in 1860. The only occasions on which he has been absent from Stonyhurst for any length of time were for studying theology at St. Beuno's College (four years) and to take part in scientific expeditions. Among these expeditions we may mention the magnetic survey of France in 1868-9, the transits of Venus in 1874 and 1882, when he was stationed at Kerguelen and Madagascar respectively; and the eclipses of 1886, 1887 and 1889 at the West Indies, Russia and the Salut Isles. He was elected fellow of the Royal Society in 1874, and he belonged to several other learned societies. He commanded the respect of all who were acquainted with his personal character and his scientific work, by his utter self-abnegation when there was work to be done, being always ready to volunteer regardless of the intense sufferings from sea sickness which the expeditions cost him. His death will be a subject of great regret, not only to the small circle of students at Stonyhurst, whose affections he had won, but to men of all classes in North Lancashire to whom he was well-known."

On this we have but two comments to make (1) the peculiar happiness of the phrase "utter self-abnegation," no words in the language better describe Father Perry's character. (2) North Lancashire, and even England will not alone "greatly regret" his loss, we know full well how warm a welcome awaited him in many a home across the seas.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JUNE, 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.									
England, London	84.5	6	46.9	1	72.7	53.4	52.4	74	126.3	39.6	2.03	6	5.6
Malta	99.0	26	58.2	1	81.4	65.4	62.2	72	150.1	52.0	.00	0	1.5
<i>Cape of Good Hope.</i>	74.8	30	37.0	6	62.7	47.3	...	...	...	...	3.42	9	3.8
<i>Mauritius</i>	77.7	4	58.0	18	75.5	65.0	61.0	75	124.4	48.5	1.53	14	5.2
Calcutta	98.4	7, 8	72.5	4	91.3	78.6	78.9	82	161.0	32.8	15.35	21	7.3
Bombay	98.6	4	76.0	21, 27	87.7	80.0	77.8	83	144.0	73.8	19.89	24	7.3
Ceylon, Colombo	87.4	5	73.8	28	85.1	77.1	72.5	78	147.2	71.8	2.33	16	7.7
<i>Melbourne</i>	66.0	2	37.6	27	57.3	46.9	45.3	77	119.2	28.9	2.78	16	7.0
<i>Adelaide</i>	68.3	4	38.5	25	59.1	48.6	47.9	80	119.9	29.9	4.75	22	7.1
<i>Wellington</i>	60.0	1	31.5	13	53.2	42.9	41.7	79	107.0	25.0	4.04	22	5.0
<i>Auckland</i>	68.0	8	40.0	15	58.9	49.6	49.0	81	111.0	32.0	10.41	25	8.0
Jamaica, Kingston	...	...	...	...	...	...	...	...	...	...	...	...	...
Trinidad	92.0	16	67.0	26	88.7	70.9	71.5	75	158.0	60.0	11.66	21	...
Toronto	78.3	20	44.2	6	68.5	52.0	54.0	81	...	38.2	3.56	17	6.8
New Brunswick, Fredericton	85.2	30	41.0	18	73.7	52.8	56.3	74	...	...	2.89	15	6.5
Manitoba, Winnipeg ...	95.6	28	33.3	3	79.5	46.8	46.9	58	...	...	.45	9	4.6
British Columbia, Victoria	80.0	2	37.0	6	70.4	46.9	...	...	...	...	.77	5	...

a And 4, 25.

REMARKS, JUNE, 1889.

MALTA.—Mean temp. 71°·8; mean hourly velocity of wind 9·0 miles. The Sea temp. rose from 70°·1 to 74°·8. Sea fog on 23rd J. SCOLES.

Mauritius.—Mean temp. of air 0°·4 below, mean dew point 0°·4 above, and E 0·37 in. below their respective averages. Mean hourly velocity of wind 9·5 miles, or 2·0 below the average; extremes 24·9 on 27th and 0·0 on 18th. Prevailing winds S.E. by E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 3°·0, of dew point 1°·9; amount of cloud .4, and E 0·82 in. above average; humidity 3, and pressure 0·248 in. below average. Prevailing wind N.; strong on 12 days. Heavy squalls on 4 days; heavy dew on 6 days; dense fogs on 2 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Persistently low barometer during the greater part of the month, due to the continued presence of elongated areas of low pressure S of the continent. Temp. 2° above the average at night and 1° below in the day, giving an unusually small diurnal range. Cloud and E much above the average, and evaporation very small. C. TODD, F.R.S.

Wellington.—A dull wet unpleasant month with only a few fine days, and generally light winds from S.E., with frequent calms. Very cold and frosty on 13th, with H at night. R. B. GORE.

Auckland.—An exceedingly wet and stormy month, the E being the heaviest in June since 1860. Barometric pressure much below the average; mean temp. above it. T. F. CHESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
DECEMBER, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	2.03	XI.	Castle Malgwyn	3.24
"	Margate, Birchington...	1.26	"	Rhayader, Nantgwillt..	4.25
"	Littlehampton	1.52	"	Carno, Tybrith	3.50
"	Hailsham	1.93	"	Corwen, Rhug	1.97
"	Ryde, Thornbrough	2.26	"	Port Madoc	7.20
"	Alton, Ashdell	2.64	"	I. of Man, Douglas ..	3.54
III.	Oxford, Magdalen Col...	1.04	XII.	Stoneykirk, Ardwell Ho.	3.66
"	Banbury, Bloxham	1.87	"	New Galloway, Glenlee	6.81
"	Northampton	1.55	"	Melrose, Abbey Gate...	2.17
"	Cambridge, Beech Ho...	1.21	XIII.	N. Esk Res. [Penicuik]	3.40
"	Wisbech, Bank House..	1.48	XIV.	Ballantrae, Glendrishaig	4.14
IV.	Southend	1.22	"	Glasgow, Queen's Park.	2.98
"	Harlow, Sheering	1.21	XV.	Islay, Gruinart School..	7.49
"	Rendlesham Hall	1.17	XVI.	Dollar	2.06
"	Diss	1.22	"	St. Andrews, Pilmour Cot	1.42
"	Swaffham	1.66	"	Balquhiddy, Stronvar..	8.03
V.	Salisbury, Alderbury ...	2.15	"	Dunkeld, Inver Braan..	3.19
"	Warminster	2.01	"	Dalnaspidal H.R.S. ...	5.86
"	Bishop's Cannings	1.82	XVII.	Keith H.R.S.	1.53
"	Ashburton, Holne Vic...	4.88	"	Forres H.R.S.	1.25
"	Hatherleigh, Winsford.	2.81	XVIII.	Strome Ferry H.R.S....	8.50
"	Lynmouth, Glenthorne.	2.85	"	Fearn, Lower Pitkerrie.	1.23
"	Probus, Lamellyn	3.08	"	Loch Shiel, Glenaladale	13.61
"	Launceston, S. Petherwin	3.15	"	N. Uist. Loch Maddy ...	7.78
"	Wincanton, Stowell Rec.	2.31	"	Invergarry	7.55
"	Taunton, Lydeard Ho...	2.02	"	Loch Ness, Drumnadrochit	2.25
"	Wells, Westbur, ...	2.19	XIX.	Lairg H.R.S.	.66
VI.	Bristol, Clifton	2.25	"	Forsinard H.R.S.	...
"	Ross	1.22	"	Watten H.R.S.	1.87
"	Wem, Clive Vicarage ...	2.02	XX.	Dunmanway, Coolkelure	7.83
"	Cheadle, The Heath Ho.	2.13	"	Fermoy, Gas Works ...	3.71
"	Worcester, Diglis Lock	1.43	"	Tipperary, Henry Street	3.18
"	Coventry, Coundon	2.25	"	Limerick, Kilcornan ...	...
VII.	Ketton Hall [Stamford]	1.66	"	Miltown Malbay	5.95
"	Graham, Stainby	1.90	XXI.	Gorey, Courtown House	3.13
"	Horncastle, Bucknall ...	1.43	"	Navan, Balrath	...
"	Mansfield, St. John's St.	1.88	"	Mullingar, Belvedere ...	2.96
VIII.	Neston, Hinderton	2.62	"	Athlone, Twyford	3.48
"	Knutsford, Heathside ...	2.47	"	Longford, Currygrane...	3.29
"	Lancaster, South Road.	3.03	XXII.	Galway, Queen's Coll...	4.30
"	Broughton-in-Furness ...	8.12	"	Clifden, Kylemore	8.09
IX.	Wakefield Prison	1.73	"	Crossmolina, Enniscroe..	4.78
"	Ripon, Mickley	1.34	"	Collooney, Markree Obs.	4.98
"	Scarborough, West Bank	1.40	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	1.22	XXIII.	Warrenpoint	3.01
"	Middleton, Mickleton..	1.45	"	Seaford	2.32
X.	Haltwhistle, Unthank..	2.14	"	Belfast, New Barnsley .	3.25
"	Shap, Copy Hill	4.34	"	Bushmilla, Dundarave...	4.29
XI.	Llanfrechfa Grange	1.95	"	Stewartstown	3.11
"	Llandovery	3.64	"	Buncrana	3.55

DECEMBER, 1889.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which -01 or more fell.	TEMPERATURE				No. of Nights below 32°
		Total Fall.	Differ- ence from average. 1870-9	Greatest Fall in 24 hours.		Deg.	Date		Deg.	Date			
				Dpth.	Date.								
I.	ENGLAND.	London (Camden Square) ...	inches 1.23	inches. — .94	in. .30	21	15	53.2	17	22.8	29	14.23	
II.		Maidstone (Hunton Court)...	1.54	— .86	.36	22	16	...	...	...	...	23.23	
III.		Strathfield Turgiss	1.58	— .44	.25	22	16	53.9	17	18.6	2	23.23	
		Hitchin	.85	— 1.20	.21	21	13	53.0	17	22.0	28	17.23	
IV.		Winslow (Addington)	1.84	— .77	.24	21	18	55.0	22a	15.0	29	20.23	
V.		Bury St. Edmunds (Westley)	1.36	— .64	.34	21	17	...	...	...	...	...	
		Norwich (Cossey)	1.27	— 1.05	.30	8	12	...	...	...	...	...	
VI.		Weymouth (Langton Herring)	2.38	...	.56	22	18	52.0	22	26.0	4	9.23	
		Barnstaple	2.44	— 1.32	.35	21	14	57.0	20	25.0	29	...	
VII.		Bodmin (Fore Street)	3.88	— 1.60	.78	21	19	...	...	...	...	...	
	Stroud (Upfield)	1.70	— .73	.61	6	17	55.0	17a	22.0	28	21.23		
VIII.	Churchstretton (Woolstaston)	2.17	— .62	.40	6	17	52.5	16	24.0	4	15.22		
	Tenbury (Orleton)	1.83	— .68	.48	6	16	54.3	17	19.0	29	20.23		
IX.	Leicester (Barkby)	1.85	— .07	.50	21	17	54.0	18	15.0	28	23.26		
	Boston	1.00	— 1.07	.25	8	10	52.0	17	20.0	29	22.23		
X.	Healey Hall [Tickhill]	1.18	...	.43	6	14	55.0	17	21.0	29	22.23		
	Manchester (Plymouth Grove)	2.30	— .15	.50	8	15	52.0	17b	27.0	7, 11	16.18		
XI.	Wetherby (Ribston Hall) ...	1.78	— .43	.54	7	10	...	...	...	...	...		
	Skipton (Arnccliffe)	3.74	— 1.54	.48	17	17	50.0	19	24.0	14	21.23		
XII.	Hull (People's Park)	1.40	— 1.12	.38	8	14	...	...	...	...	...		
	North Shields	1.42	— 1.67	.53	6	13	57.5	25	25.0	29	17.20		
XIII.	Borrowdale (Seathwaite)	16.33	+ 2.60	3.86	19	20	...	...	...	...	...		
	Cardiff (Ely)	2.57	— 1.34	.74	21	16	...	...	...	...	...		
XIV.	Haverfordwest	4.03	— 1.10	.72	19	18	52.1	15	25.4	4	10.18		
	Plinlimmon (Cwmsymlog) ...	5.00	...	.86	22	18	...	...	...	...	...		
XV.	Llandudno	2.98	+ .13	.67	19	13	55.2	17	29.0	4	4.23		
	Cargen [Dumfries]	3.90	— .63	.59	19	18	53.0	9	23.6	28	12.23		
XVI.	Jedburgh (Sunnyside)	1.54	— .91	.23	19	13	55.0	8a	25.0	14f	12.23		
	Old Cumnock	5.01	+ 1.13	.75	19	21	52.0	17	21.0	10g	13.23		
XVII.	Lochgilphhead (Kilmory)	7.92	+ 1.74	1.35	8	23	...	...	...	...	...		
	Oban (Craigvarren)	8.38	...	1.22	8	25	52.3	17	30.8	29	5.23		
XVIII.	Mull (Quinish)	9.14	...	1.16	30	26	...	...	...	...	...		
	Loch Leven Sluices	2.40	— 1.26	1.20	20	11	...	...	...	...	...		
XIX.	Dundee (Eastern Necropolis)	1.15	— 2.12	.25	20	11	54.8	17	23.3	12	13.23		
	Braemar	1.86	— 1.57	.51	19	13	52.0	17	15.7	12	17.20		
XX.	Aberdeen (Cranford) ...	2.25	...	.35	22	20	54.0	9, 17	24.0	11h	12.23		
	Lochbroom	5.64	...	.68	17	20	...	...	...	...	...		
XXI.	Culloden	.97	— .87	.26	19	...	54.0	9	25.0	5	8.24		
	Dunrobin	2.10	...	.30	22	15	58.0	17	23.5	12	12.23		
XXII.	S. Ronaldsay (Roeberry)	3.05	— .31	.37	7	24	49.0	1	29.0	12	2.23		
	Cork (Blackrock)	3.95	— .81	.60	19	17	55.0	10c	27.0	11	5.23		
XXIII.	Dromore Castle	5.82	...	.80	28	24	59.0	30	29.0	11	...		
	Waterford (Brook Lodge) ...	4.40	...	.84	28	20	55.0	9	23.0	12	4.23		
XXIV.	O'Briensbridge (Ross)	4.62	...	.53	6	20	53.0	28d	30.0	...	8.23		
	Carlow (Browne's Hill)	4.45	+ .94	.93	24	20	...	...	...	...	...		
XXV.	Dublin (Fitz William Square)	1.55	— 1.03	.27	19	15	56.6	17	30.9	6h	4.20		
	Ballinasloe	3.81	+ .33	.57	28	21	50.0	17	24.0	6	14.23		
XXVI.	Waringstown	3.11	+ .15	.63	6	19	56.0	17	26.0	13	14.19		
	Londonderry (Creggan Res.) ..	4.16	...	.65	23	23	...	...	...	...	...		
XXVII.	Omagh (Edenfel)	4.39	+ .99	.52	23	22	51.0	17	28.0	13	8.15		

a And 23. b And 18. c And 17. d And 29. e And 30. f And 29, 30. g And 27. h And 12.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON DECEMBER, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—Very variable temp., but on the whole above the average. From an agricultural point of view the weather of the entire year was exceptionally favourable. S on 5th and 6th.

ADDINGTON.—Great variations of temperature, the extreme range being 40°; the max. six times above 50, and the min. three times below 20. R fell on a good many days, but in no great quantity. Not much foggy weather, but very dense fogs on 14th and 31st, the trees being beautifully covered with rime on the latter day.

LANGTON HERRING.—B .62 in. below the average of 14 years. Sudden and great changes of temp. were a notable feature, and the mean at 9 a.m. was 1° below the average. A fine solar halo was observed on the 4th.

WOOLSTASTON.—A cold month, with sudden and abrupt variations of temp. Mean temp. 37°·7

ORLETON.—With the exception of the 9th and 10th the first 15 days were cold and frosty, with an average temp. of about 32°·5; the weather then became warmer and very changeable, with a S. or W. wind and frequent R, but not in heavy falls, till 25th, when frost set in again, and after a very fine day a cloudy sky and cold wind followed. Fogs were very frequent. Pressure was high and generally steady during the greater part of the month. Mean temp. nearly 1° below the average of 28 years. S on morning of 7th two to three inches deep and six inches on the hills.

MANCHESTER, PLYMOUTH GROVE.—Very changeable throughout. Snow and sleet on the 7th; dense fog on the 14th.

HULL.—The weather was generally overcast or cloudy, often with fog or mist.

SEATHWAITE. — In the three days 17th to 19th 7·08 in. of R fell.

WALES.

HAVERFORDWEST.—The first six days were fine, with sharp frost. From the 7th to the 23rd the weather was very changeable, every day wet and some sharp frosts. From the 24th to the end, cold, dry, frosty weather prevailed, with a considerable amount of bright sunshine. Temp. about or rather below the average of 20 years. Winds principally from S.W. and E.S.E. Lunar halo on 30th.

SCOTLAND.

JEDBURGH.—The weather was mild, and vegetation preserved its freshness, garden flowers such as primroses being in bloom all the month. The atmosphere was singularly still, with the exception of the 18th and 19th, when there was a moderate gale.

OBAN, CRAIGVARREN.—Temp. very low, but equable, throughout the month. Frequent R. Growth continued and wall-flowers remained in bloom.

LOCHBROOM.—The first and the last weeks of the month were both dry, but otherwise quite contrary, for the first was frosty and intensely cold; the latter like summer. The rest of the month was as wintry as it could be, every variety of rough weather occurring.

INVERNESS, CULLODEN.—The month generally was very fine. There were no fogs, and some of the sunrises and sunsets were exceedingly beautiful.

ROEBERRY.—Dull and damp, with winds generally from S. to S.W.

IRELAND.

CORK.—A fine average month without extremes.

DROMORE.—A very mild and open month.

WATERFORD.—E .20 in. above the average. Mean temp. 43°·6.

O'BRIENSBRIDGE, ROSS.—Mild and open weather throughout.

DUBLIN.—A quiet, mild, but damp month, with prevalent S.W. winds. The mean temp. $43^{\circ} \cdot 8$, was $2^{\circ} \cdot 7$ above the average. High winds on 13 days; gales on two days; fog on 7 days. L on 12th. A little sleet on the 28th.

WARINGSTOWN.—The whole month was unusually mild, but vegetation did not seem to be unduly forward. Snowdrops only just showing at the close.

OMAGH, EDENFEL.—The beginning of the month was very fine and mild, but from the 6th till the 23rd the weather was raw, cold, and wet, with constantly alternating frosts and thaws. Christmas day was mild and fine, the mean temp. being 46° , and the end of the month was raw and rainy.

THE ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting was held on Wednesday, December 18th at the Institution of Civil Engineers; Dr. W. Marcet, F.R.S., President, in the chair. Thirty-nine new Fellows were elected. The following papers were read:—"Report of the Wind Force Committee on the Factor of the Kew Pattern Robinson Anemometer." This has been drawn up by Mr. W. H. Dines, who has made a large number of experiments with various anemometers on the whirling machine at Hershham. Twelve of these were made with the friction of the Kew anemometer artificially increased, seven with a variable velocity, and fourteen with the plane of the cups inclined at an angle to the direction of motion. In discussing the results the following points were taken into consideration—viz., the possibility of the existence of induced eddies, the effect of the increased friction due to the centrifugal force and gyroscopic action, and the action of the natural wind. The conclusion that the instrument is greatly affected by the variability of the wind to which it is exposed seems to be irresistible; and, if so, the exact value of the factor must depend upon the nature of the wind as well as upon the mean velocity. There is evidence to show that during a gale the variations of velocity are sometimes of great extent and frequency, and there can be but little doubt that in such a case the factor is less than 2.15. The one point which does seem clear is that for anemometers of the Kew pattern, the value 3 is far too high, and consequently that the published wind velocities are considerably in excess of the true amount.

"On Testing Anemometers," by Mr. W. H. Dines, B.A. The author describes the various methods employed in the testing of anemometers, points out the difficulties that have to be encountered and explains how they can be overcome.

"On the Rainfall of the Riviera," by Mr. G. J. Symons, F.R.S. The author has collected all the available information respecting rainfall in this district. He believes that the total annual fall along the coast from Cannes to San Remo, is about 31 inches, and that any difference between the several towns has yet to be proved.

"Report on the Phenological Observations for 1889," by Mr. E. Mawley. This is a discussion of observations on the flowering of plants, the appearance of insects, the song and nesting of birds, &c. Taken as a whole 1889 was an unusually gay and bountiful year.

SYMONS'S
MONTHLY
METEOROLOGICAL
MAGAZINE.

VOLUME THE TWENTY-FIFTH.

~~~~~  
1890.  
~~~~~

LONDON :
EDWARD STANFORD, COCKSPUR STREET, S.W.

—
1891.

INDEX.

	PAGE		PAGE
Africa, Cycles of Drought and Good Seasons in	58	Frost, The March	19
Air, Remarkably Dry	7, 23	Frost, The, of 1890-91	178
Anemometers and Damage by Gales of Wind	54	Fulford, near York, Whirlwind at, March 8th	37
Anemometers, Pressure	88	Gales of Wind, Damage by, and Anemometers	54
Anemometer on the Eiffel Tower ...	9	Greenwich Mean Temperatures ..	148
Areas of Rarefaction or Depressions 23, 41, 56, 74, 85, 100, 121, 138, 149, 167		Hail Insurance	145, 180
Atmospheric Depression, Cause of..	100	Hail, Soft, Shower of	42
August 2nd, The Thunderstorm of..	120	Hailstones, Salt.....	9, 21
August 17th, Torrential Rains on...	117	Hailstorm of August 24th	123
August 24th, The Hailstorm of.....	123	Halos, Solar and Parhelia, on January 29th	1
Autumn Congresses, The.....	118, 129	Hazen's, Prof., Tables.....	112
Ball Lightning	99	Hong Kong, Great Rainfall, May 29-30th	49
Barometric Depressions 121, 138, 149, 167		July 4th and 5th, Rainfall of.....	96
Ben Nevis, Heavy Hourly Rainfall	137	July 17th, The Great Rainfall of ...	97
Ben Nevis, Rainfall on	6	Lightning, Ball.....	99
Bibliography of Meteorology.....	33	Madras, Great Rains at, 1803-88 ...	153
Brighton, On the Climate of	118	March Frost, The	19, 43
British Association at Leeds, The...	129	March 9th, Snow Storm	21
Broken Spectre in the Lake District... ..	116	March, The Cold Weather of.....	103
Buyss-Ballot, Prof. (Obituary)	8	March 8th, Whirlwind at Fulford, near York ..	37
Ceylon, Great Rainfall, Sept., 1872	54	Marriott, Mr., on Thunderstorms...	43
Cirrus Clouds, Importance of, in Foretelling Changes of Weather	10	Meteor, Fine, on March 21st.....	43
Climate, The, of the British Empire during 1889	154	Meteorological Bibliography	33
Climatological Tables for the British Empire..12, 28, 44, 76, 91, 92, 108, 124, 140, 154, 156, 172, 184		Meteorological Notes on the Months 15, 31, 47, 63, 79, 95, 111, 127, 143, 159, 175, ...	187
Cold Weather of March, The	103	Meteorological Photography	169
Congresses, The Autumn.....	118, 129	Meteorological Society, The Royal 5, 22, 36, 59, 80, 89, 168, ...	182
Cycles of Drought and Good Seasons in Africa.....	58	Meteorological Station at Pompei...	99
December 8th, 1703, The Great Storm of.....	73	Meteorology, Early	179
Depressions or Areas of Rarefaction 23, 41, 56, 74, 85, 100, 121, 138, 149 167		Meteorology in Roumania	17
Devonshire, The Great Rains of May 25th	65	Meteorology, Pre-instrumental 35, 72	179
Dry Air, Remarkably	7, 23	November, Excessive Frost in	161
Dry Period, A	144	October, Sharpest Frost for Half a Century	146
Early Meteorology	179	Our Three Hundredth Number.....	177
Earthquake, Not an.....	40	Ozone and Wind ..	70
Eiffel Tower, Anemometer on the	9	Parhelia and Halos on January 29th	1
Errata in <i>Met. Mag.</i> , 1889	116	Perry, Father, Memorial	136
Forecasting Weather	10, 64	Phenological Observations	98
Foretelling Changes of the Weather, Importance of Cirrus Cloud in ...	10	Photography, A New Application of	10
Frost, Excessive, in November....	161	Photography, Meteorological.....	169
Frost, Sharpest, in October for Half a Century	146	Pompei, New Meteorological Station	99
		Pre-instrumental Meteorology 35, 72	179
		Pressure Anemometers	88
		Rainbows, Supernumerary.....	153
		Rainfall and Temperature, Monthly 11, 14, 30, 46, 62, 78, 94, 110, 126, 142, 158, 174, ...	186

	PAGE		PAGE
Rainfall, Great, at Hong Kong, May 29-30th	49	Barometer, the Direction and Force of the Wind and Cirrus Clouds	107
Rainfall, Great, in Ceylon, Septem- ber, 1872	54	Note sur une trombe d'eau dont la bouche est en bas et dont le corps est horizontal et peut avoir quinze cents fois son diamètre	151
Rainfall, Great—The Weather Plant	32	A Comparison between the Jor- dan and Campbell-Stokes Sun- shine Recorders	152
Rainfall, Heavy Hourly, on Ben Nevis	137	Klimaschwankungen seit 1700 nebst Bemerkungen über die Klimaschwankungen der Dil- uvialzeit	183
Rainfall of July 4th and 5th	96	Roumania, Meteorology in	17
Rainfall of July 17th, The Great ...	97	Royal Meteorological Society, The 5, 22, 36, 59, 80, 89, 168, ...	182
Rainfall on Ben Nevis	6	Salt Hailstones	9, 21
Rain, Great Devonshire, of May 25	65	Sanitary Institute, The	118
Rains, Great, at Madras, 1803-88...	153	Season, A Warm, Dry	152
Rains, Two Torrential, on Aug. 19th	117	Snow Storm, March 9th	21
Rarefaction or Depressions, Areas of 23, 41, 56, 74, 85, 100, 121, 138, 149,	167	Soft Hail, Shower of	42
REVIEWS :—		Solar Radiation Thermometer	101
Strathpeffer Spa, its Climate and Waters, with Observations His- torical, Medical, and General, Descriptive of the Vicinity ...	24	Storm, The Great, of Dec. 8th, 1703	73
A Popular Treatise on the Winds, comprising the General Motions of the Atmosphere, Monsoons, Cyclones, Tornadoes, Water- spouts, Hailstorms, &c.	26	Sunburn	113, 139
The Summary of a Meteorological Journal at Crowborough	38	Supplementary Table of Rainfall ... 13, 29, 45, 61, 77, 93, 109, 125, 141, 157, 173, ...	185
Berliner Zweigverein der Deuts- chen Meteorologischen Gesell- schaft	38	Tables, Prof. Hazen's	112
Cycles of Drought and Good Seasons in South Africa	40	Temperatures, Mean, at Greenwich	148
Différentes formes des grêlons observés au sud-ouest de la Russie	60	Thermometers	178
Handbook of Meteorological Tables	81	Thermometers, Solar Radiation	101
Sur la température nocturne de l'air à différentes hauteurs	82	Thunderstorm, Heavy, May 22nd, 1728, and May 16th, 1797	73
Wanderings in Search of Health, or Medical and Meteorological Notes on various Foreign Health Resorts	103	Thunderstorm of August 2nd	120
Congrès International d'Hydrologie et de Climatologie	105	Thunderstorms, Mr. Marriott on ...	43
Weather Forecasting for the British Islands by means of a		Torrential Rains, Two, on Aug. 19th	117
		Warm, Dry Season, A.	152
		Weather Forecasting	10, 64
		Weather, Importance of Cirrus Cloud in Foretelling Changes of...	10
		Weather Plant, The	4, 32
		Whirlwind at Fulford, near York, March 8th ..	37
		Wind Changes—Pre-instrumental Meteorology	72
		Wind and Ozone	70

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCLXXXIX.] FEBRUARY, 1890. [PRICE FOURPENCE,
[or 5s. per ann. post free.

SOLAR HALOS AND PARHELIA ON JANUARY 29TH.

WE have been favoured with many accounts and sketches of the fine series of halos which appeared on the afternoon of January 29th. It would be wearisome to print them all, and we therefore select four fairly typical ones, and add an engraving which gives a general idea of the phenomenon when seen at its best. Some other notes will be found in the Remarks on the Month on page 15. It has been stated that the halos appeared earliest in the north, and gradually later further south; this is only partly true; we have plotted all the times that we can obtain, and the result is that the times increase as we go south-east, that is to say, are earliest in the N.W. of England. This is curiously corroborated by the series of sketches given in the *Daily Graphic* of January 31st, in which it will be noticed that the whole of the 22° halo is high above the horizon in the sketches from the Lake District, from Preston and from Liverpool, touches the horizon at York, and is partly below it at High Wycombe—that is to say, the phenomenon occurred in the N.W. of England when the sun was highest, and in the centre and S.E. of England when it was lower; this shows that the sketches were true as to solar altitude, and therefore are probably true in other respects. As the prevailing wind that afternoon was N.W., the above conclusions are justified and explained, the ice clouds which produced the halos evidently travelled with the wind from N.W. to S.E.

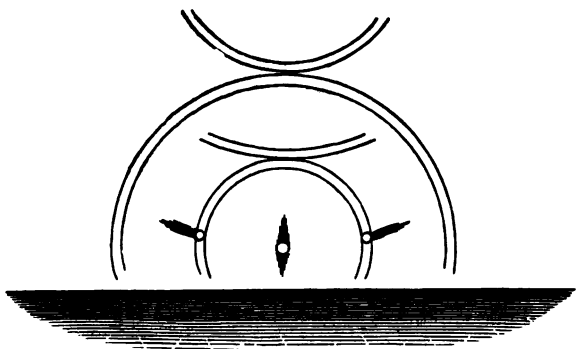
Our engraving is from a sketch kindly sent by Mr. Gulson, of Coventry, but there is great general similarity among the drawings, only some observers put the mock suns as sketched, and some put them precisely level with the real sun; and some make the two segments of circles drawn with the zenith as centre, much more acute, in fact one sketch shows the lower of the two as part of a circle struck from the vertex of the 45° halo as its centre.

A very similar, but more complex system, seen in Aberdeenshire, January 23rd, 1870, will be found described and illustrated in the *Met. Mag.*, Vol. V., 1870, p. 1, and a coloured representation of a system almost identical with that of January 29th, 1890, but as seen

in Sweden, October 4th, 1839, forms the frontispiece to *perfect* copies of Walker's translation of Kaemtz's "Meteorology."

We conclude with a suggestion. Will some competent person give a popular account of halos, thoroughly illustrated, and with the drawings on a uniform scale, and each halo clearly marked and named, so as to teach observers what to observe? Bravais' "*Memoire sur les Halos*" is too mathematical, and not suitably illustrated for any but advanced readers, and from it to the notes in most general treatises on meteorology the gulf is wide indeed.

Z



SIR,—A splendid solar halo with its accompanying parhelia was observed here this afternoon (29th) at 1.34 p.m. The halo (diameter 45°) was almost perfect; the lower part, however, was slightly obliterated by the thick atmosphere near the horizon. Attached to the upper side was an inverted portion of a similar halo, brilliantly illumined on the concave side, while the lower part shewed traces of a dull red light. Again, $22\frac{1}{2}^\circ$ above this, and also inverted, about 60° of arc, beautifully coloured with the prismatic tints, was clearly and distinctly visible, the red side innermost. This arc, if it had been produced, would have circled the zenith. The mock lights on each side of the principal halo, were drawn out into long cones of intensely bright light, while the sky inside the halo was of a very dark shade. The most noteworthy feature of the display, was a brilliant patch of pure white light in the north-western sky, at a distance of 90° from the western mock sun, and undoubtedly emanating from it, and which remained visible for nearly ten minutes. The whole phenomena disappeared at 2.8 p.m., the sky then being covered with streaky cirro-stratus haze from the N.N.W.

P.S.—A beautiful lunar halo was observed in the evening.

J. LOVELL.

Driffield, January 29th, 1870.

SIR,—Two parhelia or mock suns were well seen here on Wednesday afternoon last. The sun was encircled, or nearly so, with a luminous circle of above 22° radius, on the extreme limits right and left, and at about the same distance from the horizon as the sun itself, appeared two masses of light exhibiting vivid prismatic colours, the right hand or more northerly mock sun being of a distinctly violet hue.

The sunset which followed was most gorgeous. The western sky being ablaze with crimson light, and a column, rising perpendicularly from the horizon, nearly to the zenith, was of an intensely brilliant carmine colour.

I have never seen just such an effect before.—Yours, &c.,

H. SOUTHALL.

The Graig, Ross, February 4th, 1890.

SIR,—This afternoon the unusual phenomenon of a solar halo with three mock suns was visible here. The weather was fine and cold, with light wind from the north; the sun was bright, but shining through a very thin layer of cirro-stratus clouds. The parhelia appeared about half-past two o'clock; there were three, one on each side of, and one vertically over, the real sun, and all were distant 22° from it. They were all of very beautiful prismatic colours, with the commencement of lines running away from them, as if to form the full halo, but these lines did not complete the circle. From the upper parhelion there were traces of an inverted halo, but these were slight and like a broken rainbow. The sun was somewhat too low to see the fourth parhelion, if there was one. The phenomenon lasted for about three-quarters of an hour, and then faded away. On February 5th, 1887, there was also a very fine double halo visible round the sun in the morning here, but there were then only two parhelia.

CHRISTOPHER A. MARKHAM,
F.R.Met.Soc.

Sedgebrook, Northampton, January 29th, 1890.

SIR,—At about 2.50 p.m. on Wednesday, I observed a most interesting atmospheric phenomenon. The sun was shining faintly through a circular mass of clouds, and with the exception of about one-fourth part near the horizon, was surrounded with a large and well-defined ring or halo, tinged with prismatic colours similar to a rainbow, its angular diameter being about 60° . On each side of the circumference of the ring, or halo, appeared a circular disc of light resembling two other suns, but not so bright or so well defined as the real sun in the centre. In a few minutes the two circular images became fainter, and not so well defined, but they remained visible for about an hour. I have on several occasions seen the

sun surrounded with a large halo, or ring, but have never before noticed one like this with two mock suns, one on each side.

Shortly after the sun had set, the clouds in that part of the heavens were tinged with the most vivid crimson hues, forming a remarkable contrast with the sky beyond, which appeared to be of a brilliant green. It was truly a magnificent scene.

J. PHILLIPS.

Hereford, January 30th, 1890.

THE WEATHER PLANT.

SOMETIMES in trying to do good one does harm, in criticizing anything one advertises it—that is why we said nothing during the slight craze which existed upon the above subject about two years since.

We are not going to devote much space to it now that it has been tested and proved worthless; but if we put together some of the facts recorded they may afford a useful lesson.

The “discoverer” of the virtues of the plant was Mr. J. F. Nowack, a manufacturing chemist of Prague, and with him was associated a Mr. E. Bahlson, a market gardener of the same city.

It is not clear when this discovery was made, but it appears that application was made for an English patent as far back as December, 1887. Of course the use of the plant could not be the subject of a patent, but the joint applicants for the patent stated that “certain conditions must be observed in order to cultivate Nowack’s weather plant in such a manner that it can be used as a weather indicator. In order to obtain and maintain these conditions, we have constructed an apparatus which, in combination with the weather plant, constitutes the principal subject of our invention.”

From that date onward, glowing accounts of the merits of the plant were sent, chiefly from Vienna, to the London newspapers, such as “32,000 observations made during the last three years tend to prove its infallibility.” “The Committee of the [Vienna] Exhibition have promised Professor Nowack, a certificate to the effect that the weather forecasts made by his plants were correct in 96 cases out of 100.” These statements were too much for Mr. W. Sowerby, F.L.S., the secretary of the Royal Botanic Society, who in September, 1888, wrote a letter to *The Times*, indicating his disbelief in the merit of the plant, and who at the meeting on November 10th, 1888, exhibited the plants, and stated that “the behaviour of the several specimens varied at one and the same time according to the special conditions under which they were growing.”

This was of course no proof of what the plants would do *if grown inside the patented apparatus*, and this was promptly pointed out by a Mr. Radeke, who wrote to *The Times*, announcing himself as the London correspondent of Prof. Nowack, and giving among other statements the following:—

"The observatory of the Austrian Tourists' Club, on the Sonnwendstein, at an altitude of 1,511 mètres, in the Styrian Alps, well known to many English tourists, which supplies the various branches of the club with weather forecasts during the season, has now for already over a year, discarded both aneroid and ordinary barometers for that purpose, and depends for its forecast upon the weather plant alone."

We shall be greatly indebted to any of our Austrian readers, who will tell us whether the *abrus precatorius* has retained its position at the Sonnwendstein, or whether the discarded barometers have been fetched back.

We have but slight evidence respecting the sale of the plants and their stands (at £5 5s. 0d. each), but it must have been very remunerative if many were sold.

We next learn that the Austrian Crown Prince (Rudolph) had been much interested in the plant—possibly that throws some light upon the very favourable notices sent from Austria to the London press.

In the early half of 1889, little was heard of the plant, then Mr. Nowack came to England, and obtained from H.R.H. the Prince of Wales an introduction to Mr. Thiselton Dyer, F.R.S., the director of Kew Gardens.

Mr. Dyer (very wisely we think) waived the rule whereby experiments intended to promote pecuniary objects are excluded, and allowed Mr. Nowack to take a series of his plants and apparatus to Kew, Dr. Oliver, F.L.S., undertook to observe them in conjunction with Mr. Nowack, Mr. Nowack making the predictions, Dr. Oliver and Mr. Scott, F.R.S., comparing them with the facts.

Any one who desires to see the unsatisfactory result, should buy the *Kew Bulletin*, No. 37, 1890, published by Eyre and Spottiswoode, price 2d.

Our record will not be complete until we hear what has been done at the Sonnwendstein. We hope to ascertain that, in time for our next.

ROYAL METEOROLOGICAL SOCIETY.

The Annual Meeting of this Society was held on Wednesday evening, January 15th at the Institution of Civil Engineers; Dr. W. Marcet, F.R.S., President, in the chair.

The Council, in their Report, congratulated the Fellows on the generally prosperous state of the Society; the past year's work, though not in any respect exceptional, having been thoroughly successful. The total number of Fellows is 550, being an increase of 25 on the previous year; the finances are improving, and the Library is overflowing.

Mr. Baldwin Latham, M. Inst. C.E., was elected President for the ensuing year.

The retiring President, Dr. Marcet, then delivered an address on "Atmospheric Dust," which he divided into organic or combustible, and mineral or incombustible. The dust lighted up in a sunbeam, consists of countless motes, rising, falling, or gyrating, although it is impossible to follow any of them with the eye for longer than a fraction of a second. It is difficult to say how much of the dust present in the air may become a source of disease, and how much is innocuous. Many of the motes belong to the class of micro-organisms which are frequently the means of spreading infectious diseases. Many trades, owing to their dusty nature are very unhealthy. Some dust, when mixed with air, is inflammable and liable to explode. After giving several instances of explosions due to fine dust in flour mills, and coal mines, and illustrations of the same experimentally, Dr. Marcet referred to inorganic or mineral dust, and gave an account of dust storms and dust pillars in India. He then proceeded to describe volcanic dust, which consists mainly of powdered vitrified substances, produced by the action of intense heat. The so called ashes or scorice shot out in a volcanic eruption are mostly pounded pumice, but they also originate from stones and fragments of rocks, which, striking against each other, are reduced into powder or dust. Volcanic dust has a whitish gray colour, and is sometimes nearly white. Dr. Marcet concluded with an account of the great eruption of Krakatoa in August, 1883.

The address was illustrated by a number of lantern photographs.

RAINFALL ON BEN NEVIS.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall here last month was so exceptionally great that I send a copy of the daily rainfall copied from the monthly sheets, it amounts to the large quantity of 29·421 inches. We had only four hours sunshine, less than half any previous month.

Yours, very truly,

R. C. MOSSMAN.

Ben Nevis Observatory, Fort-William, February, 3rd, 1890.

1 ...	·085	12 ...	1·093	22 ...	·329
2 ...	·059	13 ...	2·045	23 ...	·126
3 ...	·063	14 ...	3·881	24 ...	·468
4 ...	·123	15 ...	·460	25 ...	2·569
5 ...	2·322	16 ...	·994	26 ...	·607
6 ...	1·058	17 ...	·653	27 ...	·506
7 ...	1·711	18 ...	·300	28 ...	·026
8 ...	·719	19 ...	·700	29 ...	·270
9 ...	1·347	20 ...	1·174	30 ...	1·922
10 ...	1·576	21 ...	·607	31 ...	·831
11 ...	·797				

Total for month = 29·421.

Of the heavy fall of 3·881 on the 14th—

1·68 inches fell in 2 hours.

2·45	"	"	4	"
3·31	"	"	7	"

REMARKABLY DRY AIR.

To the Editor of the Meteorological Magazine.

SIR,—Are not the annexed readings worthy of notice? I thought, on reading the German instruments at 2 p.m. on the 27th, that something must be wrong to produce so great a difference in winter. But as the hair hygrometer gave the humidity as only 5, I went to my own "Stevenson" in the garden, where I have dry and wet of Casella's best, and a self-recording one of Negretti's, and they all agreed; also another at my sitting-room window about 10 feet under the German cage. Jelinek's tables, which they use here for relative humidity, do not allow for such readings, and Guyot's, if I read them rightly, confirm the hair hygrometer.

I never saw solid snow go so fast. I find, on reference to former years, that five *cm.* (two inches) of solid snow which has lain for two months or more has, *at the end of March*, required two or three days to melt, but this vanished in five hours without any sun power.

The air was drying all the previous day, the relative humidity being: 8 a.m., 90 (under influence of hoar frost); 2 p.m., 68; 8 p.m., 46. It was most unpleasant to the feeling, nails and skin splitting on hands, quill pen nibs opening, ink drying in stand, &c.

Faithfully yours,

MICHAEL FOSTER WARD.

Partenkirchen, Bavaria, 29th January, 1890.

Bavarian cage at N. window, 20 ft. abv. ground.							Stevenson's stand in garden, Two sets of thermometers.					
1890. January.	Dry.	Wet.	Diff.	Lambrecht's Hair Hygro.	Jelinek's Tables.	Guyot.	Dry.	Wet.	Diff.	Höttinger's Hair Hygro.	Jelinek's Tables.	Guyot.
8 p.m. 26th	38.1	32.0	6.1	49	47	44	32.0	27.0	5.0	49	52	50
8 a.m. 27th	41.9	34.3	7.6	40	40	37	41.0	34.0	7.0	40	...	41
2 p.m. "	55.4	38.8	16.6	5	...	4	55.0	39.0	16.0	5	...	7
3 " "	54.7	38.8	15.9	5	...	7	53.0	39.0	14.0	5	...	14
4 " "	54.0	38.1	15.9	7	...	5	54.0	39.0	15.0	4	...	10
5 " "	54.0	37.8	16.2	7	...	4	53.0	38.0	15.0	4	...	8
6 " "	54.0	37.4	16.6	7	...	2	54.0	39.0	15.0	4	...	10
8 " "	52.5	37.4	15.1	10	...	7	53.0	38.0	15.0	6	...	8
9 " "	50.0	38.1	11.9	20	25	20	50.0	38.0	12.0	20	24	20

8 p.m. 26th, to 8 a.m. 27th, calm; 2 p.m. to 9 p.m., violent N.W. gale, with dense cir. str. travelling rapidly from N.W.

[We quite agree with Col. Ward as to the exceptional character of these records—we should have mistrusted both our eyes and our brains had we seen such differences—and yet it is not easy to see where error can have crept in. Four sets of dry and wet bulbs, and two hair hygrometers, are not at everybody's command; and they agree well, and are supported by the rapid disappearance of the snow, and by the cracking of the skin and nails.]

Of course, in England we do not know what excessive dryness is. The most remarkable English cases that we can find are :-

Met. Mag. vol. xi. (1876) p. 176.	Wensleydale, Yorks.	Rev. F. W. Stow.
1877, January 2.....	Dry, 24°·5 Wet, 18°·9	Humidity, 30.
Met. Mag. vol. xxi. (1886) p. 89.	Parkstone, Dorset.	R. H. Barnes, Esq.
1886, July 4	Dry, 85°·2 Wet, 63°·1	Humidity, 28.

Of Foreign cases we select four :—

Met. Mag. vol. ix. (1874) p. 4.	Algiers.	M. Bulard.
1865, August 25 ...	Dry, 113°·0 Wet, 68°·0	Humidity ?*
Met. Mag. vol. ix. (1874) p. 112.	Meean Meer, Punjab	W. Strahan, Esq.
1873, June 19.....	Dry, 112°·2 Wet, 70°·2	Humidity 8.
Indian Met. Memoirs, vol. i. p. 103	Káshgár, 39°24' N.	76°7' E.
		Dr. Scully.
1875, March 7	Dry, 61°·6 Wet, 41°·4	Humidity, 6.
Indian Met. Memoirs, vol. i. p. 333	Allahabad, 25°26' N.	81°52' E.
		S. A. Hill, Esq.
1879, May 4	Dry, 111°·6 Wet, 70°·6.	Humidity, 7.

Ed.]

Byss-Ballot.

ONE by one, with saddening frequency, those whose names are known to Meteorologists of all countries are leaving us. On Sunday night, February 2nd, from his well-loved home at Utrecht, passed away the spirit which gave to the world the useful "Byss-Ballot's Law," by which the author will be remembered long after his many personal friends have themselves been removed. Prof. Byss-Ballot was often in this country; he was a corresponding member of the British Association, and attended its meetings, and he was one of the nineteen honorary members of the Royal Meteorological Society. He was 72 years of age, was an Honorary Member of the Society of Arts, of the German and of the Austrian Meteorological Societies, and Knight or Commander of Orders in Austria, Netherlands, Portugal and Prussia.

Besides discharging the duties of his Professorship from 1847 to 1887, Dr. Ballot was director, indeed almost creator, of the Royal Meteorological Institute of the Netherlands. In 1883 a new island, discovered by the Dutch Meteorological Expedition, in 70° 25' 28" N., was named after him as Byss-Ballot's Island, and in 1887, on giving up his professorial duties, a sort of International banquet was given in his honour, and he was presented with a gold medal specially struck to commemorate the event. Dr. Ballot's earliest scientific papers were upon chemistry and physics, but for forty years nearly all his time and thought has been devoted to meteorology, and his contributions have appeared not only in Dutch, but in German, French, and English.

* No table deals with such a case.

SALT HAILSTONES.

To the Editor of the Meteorological Magazine.

SIR,—Calling back attention to page 169 of Vol. 24, I beg to say, that after an exceedingly stormy night, I, on the morning of the 19th January, observed on the window panes a slight film, which I tasted and found pretty salt, as did my niece. The coast of Ayrshire, about 30 miles off, is the nearest sea the salt could have come from, but as the wind was nearly south it may have come from the Bay of Luce in the Solway, more than twice that distance. In either case it had to cross the range of hills dividing Ayrshire from Clydesdale, where it would be projected upwards to a considerable altitude before it found a final resting at Cambuslang, 150 feet above the sea level. I do not know if there was hail during the night (min. temp. 36° Bar. below 29 inches) but during the forenoon of the 19th sleety showers fell at intervals. 0·18 inch of rain fell during the 24 hours previous to 9 a.m., with much lightning from 7 to 9 p.m.; 0·97 inch of rain in the following 24 hours, with some hail.

HENRY MUIRHEAD.

THE ANEMOMETER ON THE EIFFEL TOWER.

To the Editor of the Meteorological Magazine.

SIR,—At page 182, Vol. 24, you say:—"On the tower top the wind is, on the average, much stronger than below, which is, of course, readily explained by the absence of retardation by friction against trees and buildings, but what is not so easily explained is the further fact that the times of maximum and of minimum are almost reversed."

I should like to offer a suggestion in reference to the time-reversal of velocities.

Whatever may be the agencies by which the equilibrium of the atmosphere gets disturbed, air where dense is gravitationally compelled to move towards neighbouring localities, where the air is more rarified and therefore lighter (not *depressed* as our meteorological authorities teach the general public day-after-day). In the day-time the sun heats the ground, the warmed ground heats the contiguous air rarifying it. The cooler, denser air from whatever quarter, say, at times in summer from the Atlantic, flows towards Central Europe, to displace the rarified air. Hence arises increased surface velocity, which reaches a maximum shortly after midday, and declines as the influence of the sun declines, till its speed nearly reaches its minimum shortly after midnight, and so remains with little change till about 5 a.m., before which the ground will have reached its coolest. Then as daylight again induces rarefaction the daily course goes on as before.

I suppose that this is acknowledged as the cause of the alternation

"below." In reference to the reversal of time "above," I offer the following explanation:—

The friction of trees, &c., is held to be the reason for the relatively less velocity below. Well, during the heat of the day the lower rarified air is compelled to ascend in consequence of its own expansion, and its displacement by denser air. The uprising columns or strata will act on the higher current much in the same fashion as the trees do below, obstructing and lessening its velocity by friction. Whereas there being but little uprising during the cooler hours of the night the obstruction will, of course, be much less.

HENRY MUIRHEAD, LL.D.

Cambuslang, January 20th.

ON THE IMPORTANCE OF CIRRUS CLOUDS, IN FORE-TELLING THE CHANGES OF THE WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—Can you find a corner in the *Met. Mag.* for the following notes?

I recollect when only a lad an old shepherd telling me we were going to have a thaw within 48 hours, it having been a long continued frost. On enquiring how he knew, he directed me to look up to the westward, where the sky was streaked with cirrus clouds *pointing from north to south*, and sure enough the thaw came as prophesied. I have never forgotten the above incident, and from life-long observations have found the rule nearly always to come true. The reason for it being that cirrus clouds appearing in the western horizon and laying from *north to south* foretell a change in the wind to the west or south-west; and south-west winds in our district almost invariably bring warmer weather.

I have noticed the opposite, viz., when cirrus clouds form on the northern horizon, and point from *west to east*, we are going to have a change in the wind to the north, with colder weather. These changes can often be foretold long before the barometer has given notice of a change.

I find the only exception to being sure of a thaw on noticing the cirrus in the west, is in the late spring time, when our east winds are so prevalent, when probably they are too strong for the western current to assert itself sufficiently.—Yours truly,

AMOS MITCHELL.

Wolsingham, Darlington.

A NEW APPLICATION OF PHOTOGRAPHY.

Photography, according to a foreign scientific journal, is about to be put to a new use in meteorological work. The determination of the temperature of the air at different heights is an important factor

in meteorological investigations, and, as our readers may easily imagine, is a difficult problem to undertake, but the following outline of the new method suggests that something feasible has been designed. Herr Siegsfeld uses a thermometer which, by closure of an electric circuit when certain temperatures are reached, gives a light signal. Small balloons, each containing such a thermometer, will be sent up at night, and the light will affect photographically a so-called *photo-theodolite*, while the height then attained will be indicated in a mechanical way. It is hoped that this new method will enable more exact formulæ for decrease of temperature with height to be obtained.—*British Journal of Photography*.

[There may be more in this scheme than is explained, as it stands it seems to us hopelessly wild.—ED. M.M.]

THE NEW AVERAGE ADOPTED IN THE GENERAL TABLE.

There are two conflicting interests, between which it is necessary to decide, in compiling such a table as that on p. 14. There are more than two—there are half-a-dozen, but of only two need I write now, viz., completeness and continuity. It is evidently desirable that the column giving the difference between the fall of rain in (say) January and the average in January, should be given for as many stations as possible; this I call completeness. It is also desirable that the average be that of a period long enough to give a trustworthy average. Moreover, it would not be at all uniform or satisfactory to take averages of different periods. Some of the records go back only 6 or 7 years, others to nearly the beginning of the century. When commencing this magazine, just 25 years since, I was obliged to be content with the average of the six years, 1860-5, and it was used until I had that for 1870-9, and was obliged to adopt it, because so few stations went back to 1860. It may be said, why change from 1870-79? or why not take the 20 years, 1870-89? To this I reply, because by adopting 1880-89 I can give the average for 45 stations out of 50, while by using either 1870-9 or 1870-89 I should have had a much smaller proportion, certainly less than 40 out of the 50, and as I have said over and over again in *British Rainfall* the excessive fall of rain in 1872 rendered the fall in that decade above the true average.

G. J. SYMONS.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JULY, 1889.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	80·9	5	46·1	19	71·0	54·0	52·1	73	126·3	41·4	2·64	17	6·8
Malta	104·1	20	63·3	4	86·7	69·6	64·9	67	158·8	56·6	·00	0	0·9
<i>Cape of Good Hope.</i> ...	77·0	30	38·4	...	62·5	46·0	...	...	...	...	3·31	9	5·7
<i>Mauritius</i>	76·4	19	58·4	6	74·3	64·8	60·9	76	123·5	48·6	2·21	17	5·6
Calcutta	92·4	13	74·8	3	88·8	78·7	79·5	86	159·3	75·1	11·99	22	7·0
Bombay	88·1	1	75·7	11	84·8	77·9	77·0	87	145·7	74·8	30·45	27	8·6
Ceylon, Colombo	86·0	22	73·0	19	84·4	76·6	72·2	78	146·8	70·6	7·43	24	7·5
<i>Melbourne</i>	62·1	31	31·3	12	55·4	40·6	42·1	81	110·4	23·5	1·64	8	6·4
<i>Adelaide</i>	65·9	30	36·3	19	57·8	43·2	43·9	79	119·0	29·0	1·21	14	5·3
<i>Wellington</i>	58·5	1, 24	33·0	17	53·4	40·5	39·5	76	108·0	23·0	3·15	16	4·2
<i>Auckland</i>	65·0	25	40·0	8	57·7	46·5	45·9	80	118·0	30·0	4·38	22	6·7
Jamaica, Kingston	94·3	28	71·9	8	90·0	73·9	73·7	77	...	...	·85	...	...
Trinidad	94·5	8	64·0	7	86·6	72·6	72·9	82	156·5	...	12·14	27	...
Toronto	88·7	8	47·7	25	78·4	59·9	60·6	75	...	41·0	3·26	13	4·5
New Brunswick, Fredericton	84·7	1	45·0	27	74·3	55·0	56·7	71	...	...	1·26	12	5·5
Manitoba, Winnipeg ...	92·8	17	40·3	13	75·3	52·0	55·7	73	...	...	2·38	14	5·1
British Columbia, Victoria	85·0	8, 9	40·0	2	73·2	48·2	...	...	...	...	·00	0	...

REMARKS, JULY, 1889.

MALTA.—Mean temp. 76°·9; mean hourly velocity of wind 7·7 miles. The sea temp. rose from 74°·8 to 81°·5. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, of dew point 1°·6, and E·04 in. above their respective averages. Mean hourly velocity of wind 10·3 miles, or 1·8 below average; extremes 26·5 on 1st and 1·9 on 27th. Prevailing direction E.S.E.

COLOMBO.—TSS occurred on 13th and 14th; L only was seen on the 15th and 23rd. C. MELDRUM, F.R.S.
J. C. H. CLARKE, LIEUT.-COL. R.E.

Melbourne.—Mean temp. of air 0°·2, of dew point 0°·7, humidity 1, and mean amount of cloud 0·1, above average; E·08 in. below average. Prevailing wind N. and N.E.; strong on 4 days. Heavy dew on 9 days; dense fog on 10 days; hoar frost on 6 days; lunar halos on 5th and 10th. R. L. J. ELLERY, F.R.S.

Adelaide.—Barometer unusually high, the mean (30·274) being one-tenth above the average of 32 years. Mean temp. 1°·2 below average; E half the average, although the total fall for the first seven months of the year is greater than any previously recorded. C. TODD, F.R.S.

Wellington.—The first few days were fine, with fresh N.W. wind; from 5th to 14th it was showery, with S.E. and S.W. winds. The remainder of the month was generally fine, with moderate wind, chiefly N.W. S on hills on 14th; H on 7th; fog on 4 days. Mean temp. 0°·7 below the average. Rainfall half the average. R. B. GORE.

Auckland.—The early and middle parts of the month were showery and unsettled, with N.W. to S.W. winds; the close comparatively fine, with E. or N.E. winds. Mean temp. close to the average; rainfall slightly below the average.

T. F. CHKESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, JANUARY, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	3·70	XI.	Castle Malgwyn	7·49
„	Margate, Birchington...	1·98	„	Builth(Llanwrtyd Wells)	10·61
„	Littlehampton	2·83	„	Rhayader, Nantgwillt..	11·44
„	Hailsham	3·44	„	Carno, Tybrith	9·39
„	Ryde, Thornbrough	4·71	„	Corwen, Rhug	6·09
„	Alton, Ashdell	4·49	„	I. of Man, Douglas	4·52
III.	Oxford, Magdalen Col...	1·86	XII.	Stoneykirk, Ardwell Ho.	3·62
„	Banbury, Bloxham	2·70	„	New Galloway, Glenlee	8·25
„	Northampton	2·21	„	Melrose, Abbey Gate...	3·96
„	Cambridge	...	XIII.	N. Esk Res. [Penicuik]	5·35
„	Wisbech, Bank House..	2·15	XIV.	Ballantrae, Glendrisaig	4·96
IV.	Southend	1·73	„	Glasgow, Queen's Park.	6·14
„	Harlow, Sheering ...	1·78	XV.	Islay, Gruinart School..	7·65
„	Rendlesham Hall	1·92	XVI.	Dollar	5·65
„	Diss	2·16	„	Balquhiddier, Stronvar..	18·40
„	Swaffham	2·59	„	Dunkeld, Inver Braan..	9·23
V.	Salisbury, Alderbury ...	4·07	„	Dalnaspidal H.R.S.	15·17
„	Warminster	...	„	Arbroath Cemetery	2·52
„	Bishop's Cannings	3·05	XVII.	Keith H.R.S.	2·25
„	Ashburton, Holne Vic... 11·99		„	Forres H.R.S.	2·54
„	Hatherleigh, Winsford.	3·56	XVIII.	Fearn, Lower Pitkerrie.	3·37
„	Lynmouth, Glenthorne.	7·64	„	Loch Shiel, Glenaladale	19·51
„	Probus, Lamellyn	4·99	„	N. Uist, Loch Maddy ...	10·77
„	Launceston, S. Petherwin	6·42	„	Invergarry	16·36
„	Wincanton, Stowell Rec.	3·38	„	Aviemore H.R.S.	4·69
„	Taunton, Lydeard Ho... 3·81		„	Loch Ness, Drumnadrochit	7·22
„	Wells, Westbury, ...	2·85	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	3·90	„	Secourie	6·76
„	Ross	3·61	„	Watten H.R.S.	1·66
„	Wem, Clive Vicarage ...	3·59	XX.	Dunmanway, Coolkelure	11·61
„	Cheadle, The Heath Ho.	3·75	„	Fermoy, Gas Works ...	5·18
„	Worcester, Diglis Lock	2·55	„	Tipperary, Henry Street	4·67
„	Coventry, Coundon	3·27	„	Limerick, Kilcornan ...	5·85
VII.	Ketton Hall [Stamford]	2·02	„	Milton Malbay	6·61
„	Grantham, Stainby	2·31	XXI.	Gorey, Courtown House	4·28
„	Horncastle, Bucknall ...	2·52	„	Navan, Balrath	2·59
„	Mansfield	4·26	„	Mullingar, Belvedere ...	5·18
VIII.	Neston, Hinderton	2·46	„	Athlone, Twyford	4·66
„	Knutsford, Heathside ...	3·20	„	Longford, Currygrane...	4·52
„	Lancaster, South Road.	6·66	XXII.	Galway, Queen's Coll... 5·88	
„	Broughton-in-Furness ..	8·87	„	Clifden, Kylesmore	8·37
IX.	Wakefield Prison	2·57	„	Crossmolina, Enniscoe..	8·86
„	Ripon, Mickley	4·77	„	Collooney, Markree Obs.	5·07
„	Scarborough, West Bank	2·04	„	Ballinamore, Lawderdale	...
„	East Layton [Darlington]	2·85	XXIII.	Warrenpoint	3·44
„	Middleton, Mickleton... 4·05		„	Seaford	3·60
X.	Haltwhistle, Unthank... 3·80		„	Belfast, New Barnsley .	3·57
„	Shap, Copy Hill	12·47	„	Bushmills, Dundarave...	4·36
XI.	Llanfrechfa Grange	6·71	„	Stewartstown	3·86
„	Llandovery	7·99	„	Buncrana	4·60

JANUARY, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				No. of Nights below 32°	In shade. On grass.
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Deg.		Date	Deg.	Date			
				In.	Dpth.								
I.	ENGLAND.	London (Camden Square) ...	2.46	+	.84	.35	27	21	55.6	25	26.1	2	4 11
II.		Maidstone (Hunton Court)...	2.34	+	.79	.49	28	22	...	...	...	...	...
III.		Strathfield Turgiss	3.11	+	1.30	.41	27	25	54.1	7	20.8	2	5 18
IV.		Hitchin	2.29	+	.75	.39	27	20	54.0	9	23.0	1	6 ...
V.		Winslow (Addington)	2.16	+	.35	.41	27	23	55.0	7, 25	16.0	2	9 17
VI.		Bury St. Edmunds (Westley)	2.14	+	.67	.30	27	19	...	...	...	...	...
VII.		Norwich (Cossey)	2.41	+	.92	.38	28	18	...	...	...	...	...
VIII.		Weymouth (Langton Herring)	3.71	+	1.37	.48	27	25	54.0	25	25.0	2	4 ...
IX.		Barnstaple	3.28	+	.26	.50	27	23	56.0	25	30.0	3	...
X.		Bodmin (Fore Street)	7.44	+	3.43	.73	4, 21	28	...	...	...	...	...
XI.	WALES.	Stroud (Upfield)	3.19	+	.99	.38	25	20	56.0	6, 9	21.0	1	5 ...
XII.		Churchstretton (Woolstaston)	4.66	+	2.50	.92	21	27	53.0	6, 31	20.5	3	10 17
XIII.		Tenbury (Orleton)	3.38	+	1.24	.53	21	23	55.2	6	19.0	2	16 14
XIV.		Leicester (Barkby)	2.38	...	...	.62	26	25	56.0	25	16.0	1	13 20
XV.		Boston	1.74	+	.35	.60	28	16	55.0	25	23.0	2	11 ...
XVI.		Hesley Hall (Tickhill)	2.39	+	.62	.63	26	19	55.0	6a	21.0	3	10 ...
XVII.		Manchester (Plymouth Grove)	3.30	+	.84	.85	26	24	55.0	6	29.0	1, 29	5 12
XVIII.		Wetherby (Ribston Hall) ...	2.59	+	.70	.64	22	14	...	...	...	...	...
XIX.		Skipton (Arcliffe)	10.65	+	5.00	1.29	21	29	...	...	...	...	...
XX.		Hull (People's Park)	2.36	+	.59	.87	26	19	...	...	...	...	...
XXI.	SCOTLAND.	North Shields	1.87	+	.28	.38	8	17	57.0	7	21.0	3	11 11
XXII.		Borrowdale (Seathwaite)	21.80	+	9.62	2.70	21	27	...	...	...	...	...
XXIII.		Cardiff (Ely)	5.89	+	2.68	.80	26	24	...	...	...	...	...
XXIV.		Haverfordwest	6.54	+	2.12	.98	21	24	52.0	6, 7	22.8	1	2 4
XXV.		Plinlimmon (Cwmsymlog) ...	7.49	...	...	1.42	21	26	...	...	...	...	...
XXVI.		Llandudno	3.68	+	1.40	1.03	21	24	57.8	7	32.5	28	...
XXVII.		Cargen [Dumfries]	6.29	+	2.52	.90	21	22	53.6	31	26.8	3	7 ...
XXVIII.		Jedburgh (Sunnyside)	2.56	+	.84	.36	22	18	54.0	6	26.0	20	12 ...
XXIX.		Old Cumnock	6.26	+	2.27	.58	4	28	51.0	25	23.0	28	6 ...
XXX.		Lochgilthead (Kilmory)	11.57	+	5.43	1.13	19	30	...	...	...	...	...
XXXI.	IRELAND.	Oban (Craigvarren)	8.86	...	...	.80	23	30	54.0	16	31.0	23	2 ...
XXXII.		Mull (Quinish)	10.05	+	4.38	1.03	18	28	...	...	...	...	...
XXXIII.		Loch Leven Sluices	5.70	+	2.80	1.20	20	17	...	...	...	...	...
XXXIV.		Dundee (Eastern Necropolis)	2.40	+	.43	.35	9	15	53.1	7	24.0	23	6 ...
XXXV.		Braemar	8.12	+	5.43	1.51	17	24	51.7	7	14.6	23	9 14
XXXVI.		Aberdeen (Cranford) ...	2.83	...	...	.54	9	24	54.0	31	19.0	23	9 ...
XXXVII.		Strome Ferry	13.55	+	7.56	1.20	25	30	...	...	...	...	...
XXXVIII.		Culloden	3.39	+	1.77	1.11	20	9	55.0	16	27.0	23	6 24
XXXIX.		Dunrobin	...	...	...	...	...	...	...	...	...	...	...
XL.		S. Ronaldsay (Roseberry)	3.24	+	.29	.67	24	19	50.0	30	31.0	23	5 ...
XLI.	Cork (Blackrock)	6.13	+	1.53	.83	17	26	54.0	9, 31	27.0	28	5 ...	
XLII.	Dromore Castle	6.87	+	.80	.90	4	22	54.0	16	26.0	28	...	
XLIII.	Waterford (Brook Lodge) ...	5.94	+	2.38	1.12	21	22	54.0	18	29.0	29	3 ...	
XLIV.	O'Briensbridge (Ross)	5.50	...	...	.98	26	25	54.0	11	28.0	29	7 ...	
XLV.	Carlow (Browne's Hill)	...	...	...	...	...	...	...	...	...	...	...	
XLVI.	Dublin (Fitz William Square)	2.98	+	1.12	.84	26	21	56.8	16	31.1	29	1 14	
XLVII.	Ballinasloe	6.08	+	3.00	.95	26	28	50.0	11	24.0	29	16 ...	
XLVIII.	Waringstown	3.56	+	.91	.50	6	23	55.0	11b	27.0	22c	10 19	
XLIX.	Londonderry (Creggan Res.) ..	4.31	+	.89	.47	14	26	...	...	...	...	...	
L.	Omagh (Edenfel)	4.70	+	1.68	.71	9	28	54.0	16	30.0	22c	7 14	

a And 7, 9, 25. b And 16. c And 28.

+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JANUARY, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A very mild month; thermometer at times very high, but on the whole wet, with only six days on which R did not fall.

HITCHIN.—The highest mean temperature on record, $42^{\circ}1$, the average for 40 years being $35^{\circ}8$.

ADDINGTON.—The month opened with sharp frost, lasting two days. On the 2nd, dense fog; 3rd, heavy rime; the rest of the month remarkably open and mild. The max. shade temp. was 50° or above on 15 days, and 55° was reached on two occasions. Wind often very high, R falling frequently, that of the 26th and 27th causing a large flood. From 3.30 to 4 p.m. on the 29th three mock suns were seen, the right and left ones very distinct; the upper one was not so bright.

BURY ST. EDMUNDS, WESTLEY.—The month has been very mild, and vegetation is much more forward than usual.

LANGTON HERRING.—On 17 days the temp. rose to 50° or above. On the 25th the temp. was 50° at 9 a.m. and rose to 54° in the day, the highest January temp. for 19 years. A great storm occurred on the 22nd and 23rd. T on 19th and 23rd, L on the 21st, three mock suns on the 29th. A mild, wet month has brought vegetation very forward.

BODMIN, FORD STREET.—A very wet and stormy month, but very mild.

STROUD, UPPFIELD.—Gales on many days. From the 17th to the 22nd (both inclusive) the air was very electrical, storm clouds about, going in different directions. Flakes of S on the 20th and 28th; hail on 21st; on the 26th a strong S.W. gale.

WOOLSTASTON.—The early part of the month was very warm, the nights being exceptionally so. Gales and wild, stormy weather commencing on the 14th marked the latter half of the month till the 27th, when S fell heavily. Mean temp. $40^{\circ}9$.

ORLETON.—Severe frost on the first four days of the month, accompanied for three days by a dense fog and rime. A thaw with R then set in, and the remainder of the month till the 28th was very changeable and stormy, with great and sudden fluctuations in pressure, accompanied by strong gales of wind. There were a few fine, warm days and several frosty nights. On the night of the 26th and 27th a wet snow fell, which covered the valley 2 in. in depth and was 3 in. deep on the hills. The last three days of the month were dry and cloudy. The mean temp. was $4^{\circ}5$ above the average of the last 29 years. Distant L was seen on the night of the 20th.

LEICESTER, BARKBY.—On the 29th, from 2.55 p.m. to 3.35 p.m., was seen the beauteous and remarkable phenomenon of Parhelia or mock suns, with their attendant circles of coloured light. The mock suns, about 45° apart, had strong prismatic tints, the red being on the sides from the sun and the blue on the inner or nearest sides in each case, but without the intermediate shades. The arch which passed through them and over the sun (at its centre) was 7° of a full circle coming on each side below the mock sun, strong rays of light also stretching horizontally through them. The sun itself was blurred, the rays of light representing two cones with their bases together and their apices pointing vertically one upwards and one downwards. Another inverted arch half a circle in extent touched and rested on the arch already described; and in the zenith yet another inverted arch of half a circle, very clear and sharp, was seen, with prismatic tints on a blue sky.

MANCHESTER, PLYMOUTH GROVE.—The mean temp. was $42^{\circ}8$, the highest January temp. for the last 22 years, with the exception of 1875 and 1884; the mean temp. for January in each of those years was 43° . No dense fog during the month. Snow and sleet on the 28th. The weather upon the whole was

mild, damp, and foggy, with drizzling R. The storms at the end of the month not much felt here.

HULL.—The weather generally was wet, dull, and often stormy.

WALES.

HAVERFORDWEST.—Very mild, stormy, and wet, only 7 days without R. The month commenced with severe frost, which, however, was evanescent. Storms of great violence were frequent throughout the month. Heavy T and L at times, notably so on the 18th, accompanied by a whirlwind, which cut a lane through some gigantic beech trees in Picton Woods, snapping some, uprooting others, and some were carried a distance of 100 yards into a neighbouring field. Heavy squalls of R, H, T and L again on the 24th, during which the lightning struck at a place called Hook, exploding with a loud noise, and creating great alarm. Heavy floods, with very high tide, on the morning of the 22nd; none equal to it since January, 1868.

SCOTLAND.

CARZEN.—Very stormy, mild, and unsettled, the mean temp. being nearly 4° above the average. Vegetation is unusually far advanced. The sudden fluctuations both in the thermometer and barometer have been very marked. The somewhat unusual occurrence of the night temp. being higher than the day was observed several times during the month; the most marked instance was on the 12th, the max. day temp. being 45°, the thermometer between 11.30 p.m. and midnight standing at 51° 8.

JEDBURGH.—The temp. generally has been high, with squally winds, on several occasions almost a gale. Spring flowers are far advanced.

OBAN, CRAIGVAAREN.—A wild, wet month, with high temperature. The gales of the 18th and 25th were of hurricane force, and accompanied with T and L. Growth continued apace, and spring flowers were in bloom throughout. T and L, and H on the 5th, 12th, and 18th.

MULL, QUINISH.—Very wet and stormy. T and L on 5th, 13th, 18th, 21st, and 25th. Fearful gales from S.W. on 18th and 25th.

CULLODEN.—Particularly fine, and many days very mild, neither ice nor S.

IRELAND.

CORK.—Dulness, with almost constant drizzling R, has characterised the month, which had only 5 days without R.

DROMORE.—Month very stormy, but weather very open. Vegetation still going on.

WATERFORD.—T on the 5th and 23rd, H on the 17th, 18th and 21st, L on the 18th, 19th, and 21st, S on the 22nd, S.W. gale on the 25th.

O'BRIENSBRIDGE, ROSS.—T and L frequent in the early days of the month, indicating the approach of bad weather; a marked fall of temp. about the 17th, followed by violent gales of wind, heavy R and sleet, S and H.

DUBLIN.—A tempestuous, mild, and rainy month; rough southerly to westerly winds, frequently freshening into strong gales. Eleven gales were recorded here, some of them being downright tempests. On several occasions T and L accompanied the storms. The mean temp. was much above the average. A solar halo seen on the 29th; lunar halos were seen on the 7th and 27th. Fogs on the 1st, 2nd and 27th. H on 3 days, S or sleet on 5 days. Temp. exceeding 50° in the screen on 17 days, compared with 8 days in January, 1889, while it fell below 32° in the screen on only one night.

BALLINASLOE.—Wet and stormy, with high floods and violent gales.

WARINGSTOWN.—Very mild, with frequent high winds; grass in pastures growing almost as fast as in summer.

OMAGH, EDENFEL.—The R and temp. were both considerably above the January mean. From the 18th to the 26th a succession of strong gales, backing from S.E. to N.W., swept over the district, frequently accompanied by sleet and S. The end of the month was dull and mild.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXC.]

MARCH, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

METEOROLOGY IN ROUMANIA.*

IN our number for July, 1886, we noticed three of the earliest publications by Prof. Hepites, who has from the first been Director of the Meteorological Institute of Roumania. In that notice by-the-by, there was a remark quite unconnected with meteorology to which we may perhaps be excused for referring. By direction of the Roumanian Minister for Agriculture, Prof. Hepites had made a long tour, and studied the meteorological organizations of Europe. To this we added as a foot note, "Roumania has a Minister for Agriculture, England has not yet reached such a state of advancement." Roumania had the start. England has appointed one since we wrote. We shall watch with interest their relative progress.

In the first place we must thank Prof. Hepites for printing most of his text in French as well as in Roumanian, it is more than a convenience, it is a necessity for most of the inhabitants of western Europe.

In the preface to Vol. I., Prof. Hepites points out the scarcity of old observations in Roumania, and that, therefore, his Institute has practically no averages with which to compare results; has in fact to begin absolutely *de novo*.

He wisely begins with a long and apparently complete list of notices of observations and remarks on the climate of the country, which though fragmentary were well worth collecting. To this follows a list of books, memoirs and printed notes on, or appertaining to, meteorology which have appeared in Roumania, the most remarkable feature in which is the fact that there is not one paper before 1841, and that is apparently a physical rather than a meteorological one, viz., "Asaki, Le thermomètre ou le mesureur de

* *Studii asupra Climei Bucurestilor in Anii, 1885-88*, de Stephan C. Hepites, Directorul Institutului Meteorologic. Partea I., Temperatura aerului.—Bucurest-Tipografia Academiei, Române, 1889. 4to 72 pages, 3 plates.

Annales de l'Institut Météorologique de Roumanie. Par Stephan C Hepites.—Tomes I.-III. Bucuresti, F. Göbl Frl, 1886-89. 4to, about 600 pages each.

chaleur," published in the *Icoana Lumei* at Iassy, in 1841. The Institute is rapidly forming a good library, and prints very handsomely its list of books received.

Part II. of Vol. I., consists of 47, 4 to pages, describing the instruments at the Institute and how they are used. Prof. Hepites recognizing the fact that few Roumanians are acquainted with meteorological instruments has described them very fully, and illustrated his description by several excellent engravings. In his description of the pattern of barometer adopted by the Hamburg Seewarte (and which is much the same as our "Kew pattern"). Prof. Hepites ascribes the air trap to Bunten, not as is usual to Gay Lussac, and Prof. Hepites is right. Gay Lussac's barometers had no air trap, Bunten, who succeeded Mossey as an optician at 26, Quai Pelletier, Paris, invented the air trap, and showed it at the *Exposition des produits de l'Industrie Francaise*, in 1823, and having supplied barometers so trapped to various experienced men—Humboldt, Arago and others received from them the highest praise. Acting upon this information, Mr. Ellis in his valuable history of the barometer,* has already pointed out Bunten's claims, but it takes a long time to correct a widespread error.

Of thermometer stands Prof. Hepites has a large collection, oddly enough although Kew Observatory has long abandoned its old pattern (large enough for a hermit to dwell in) Prof. Hepites has one out at Buckharest.†

There is one respect in which Prof. Hepites could render very valuable service to meteorology, at little cost either of time or of trouble. He has three instruments for measuring evaporation, Piche's moistened paper, Wild's counterpoised dish, and a modification of Wild's, whereby it is made self-recording. No maker's name is given, but it looks as if it had been made by Hottinger. All these evaporators are in the Kew stand. We should be very glad if Prof. Hepites would have a large tank made like those used in the South of France, or the iron one formerly at Strathfield Turgiss, and now at Camden Square. A comparison of its results with those of Piche and of Wild, in a climate like that of Buckharest, would be extremely interesting, and of much importance to engineers.

We conclude our notice of this volume by extracting a few data for 1885:—

Temperature.—True mean $50^{\circ} \cdot 6$; mean $\left(\frac{M + m}{2}\right)$ $51^{\circ} \cdot 8$. Absolute max. $97^{\circ} \cdot 7$; min. $-5^{\circ} \cdot 1$.

Humidity.—Mean 76. Max. 100. Min. 25.

Rain.—Total 25.49 in. on 112 days. Max. fall 2.26 in. on June 21st.

Evaporation.—Total 13.87. Sunshine 1896 hours, or 42 per cent.

Tome II. is somewhat similar to Tome I., it reports the history of

* *Quar. Jour. Roy. Met. Soc.*, vol. xii., 1886, p. 138.

† Compare his engraving in vol. i., p. cx. with that of the Kew stand in *Met. Mag.*, vol. iv., 1869, p. 17.

the Institute for the year, then gives as full an account of the climate of Buckharest as can be compiled, and finishes with the observations in extenso for 1886, of these we take the same details as we have just given for 1885 :—

Temperature.—True mean $50^{\circ}\cdot7$; mean $\left(\frac{M + m}{2}\right)$ $51^{\circ}\cdot1$. Absolute max. $91^{\circ}\cdot4$; min. $11^{\circ}\cdot1$.

Humidity.—Mean 74. Max. 100. Min. 26.

Rain.—Total $29\cdot34$ in. on 109 days. Max. fall $2\cdot38$ on June 9th.

Evaporation.—Total $12\cdot81$ in. Sunshine 1980 hours, or 45 per cent.

We own to disappointment when we found that Tome III. was like unto Tome I. and II., very good and valuable, but wholly devoted to the Buckharest observations. Prof. Hepites has evidently a very hard struggle to obtain funds—the Roumanians are like all Europeans, willing to spend money on buildings and on instruments, but not willing to pay for brains, not willing to spend money in order to utilize the observations that are made. It is an old, old story, it is sheer waste of money and of energy to equip stations and not fully utilize the records they afford. We wonder that when the erection of a mountain observatory was proposed, Prof. Hepites did not at once say—"No, let us first get our existing system in full work, let us have the funds to reduce and publish the observations already made, and *then* we will see about the station on the Virful cu Dor." However, it is his business not ours, but we would have no costly new instruments, no new observatories, and not even publish any more Buckharest returns, until we had done justice to the observers throughout Roumania, by working up their returns for 1885-86 and 87.

THE MARCH FROST.

We hope that a frost greater than has occurred in March for nearly half a century, will be fully described. We can here only give a few notes just as they have arrived:—

CAMDEN SQUARE :—

	GLAISHER STAND.					STEVENSON SCREEN.			GRASS.		
	Max.		Min.		9 a.m.	Max.	Min.		Min.		
March 4...	40·8	...	15·6	...	20·4		41·1	...	18·0		12·8

Since 1859, there are only four instances of the min. on the Glaisher stand falling below 22° , viz.—

1862—March 4th.....	21·3
1874—March 11th	21·9
1889—March 4th	19·2
1890—March 4th.....	15·6

The average minimum during the 30 years, 1859 to 1888, was $25^{\circ}\cdot5$, so that the above is not only by far the lowest, but nearly 10° below the average.—*G. J. Symons.*

INGLESIDE, KENLEY.—Since March came in we have had a remarkable spell of cold.

	Max. deg.		Min. deg.		Min. on grass. deg.
March 1	36·5	.....	25	.....	19
„ 2	29·0	.....	24	.....	snowed up
„ 3	29·0	.....	20	.....	„
„ 4	39·0	.....	6	.....	2
„ 5	46·0	.....	29	.....	27

You will thus see that we registered on March 4th the low temperature of 6°, and on the grass 2°; and on the 5th the max. was 46°, a variation of 40° in two days. On two days the ther. never rose above 29°.—*Harold Smith.*

HARTLEY, CRANBROOK.—Lowest temp. in March for 25 years.

Year.	deg.	Date.	Year.	deg.	Date.
1866...	24	 1	1878...	20	 25
1867...	23	 17	1879...	27	 25
1868...	28	 25	1880...	26	 29
1869...	25	 4, 8	1881...	22	 1
1870...	20	 14	1882...	27	 22
1871...	29	 15	1883...	23	 10, 11
1872...	26	 21, 22	1884...	31	 1, 3
1873...	27	 1, 14	1885...	30	 8, 10, 23, 25, 26
1874...	19	 11	1886...	22	 11
1875 ..	25	 19	1887...	21	 13
1876...	24	 19	1888...	20	 1
1877...	21	 1	1889...	20	 4

1890, 10° on 4th.

George Pile.

TENTERDEN.—We have had frequent S here, but very light; 5 inches deep last night (3rd) only gave ·25 in. Excessively low temp. this morning (4th), 14° on stand, and 20° at 9 a.m. I see nothing like so low as 14° even in March, 1883, or March, 1886.—*J. Ellis Mace.*

FOX GROVE, BECKENHAM.—On the morning of the 4th inst. my thermometer on an improved Glaisher stand registered a minimum of 7°·3, the correctness of the record being confirmed by a neighbour's reading of 7°·0, about 300 yards away. This temperature is not only remarkable in itself, but the more so as marking the fourth consecutive year's severe frost in March. In 1887 there was skating in London as late as March 21st, and at the club rink in the Regent's Park there was skating till March 5th (inclusive) in 1888, on March 6th, 1889, and on March 4th and 5th, 1890.—*Percy Bicknell.*

ROYAL OBSERVATORY GREENWICH :—

March 4th—Max. 35°·0; min. 13°·1; min. on grass 8°·6.

The minimum (13°·1), is the lowest that has been recorded in the month of March, since 1845, March 13th, when also 13°·1 was registered.—*The Astronomer Royal.*

FOREST LODGE, MARESFIELD.—Before sunrise yesterday morning

4th) the radiation thermometer fell to 8° and this *beneath a coating of snow*. Had the bulb been clear, it must have gone lower. It is a standard instrument.—*William Noble*.

THE OBSERVATORY, CROWBOROUGH CROSS.—

	March 3.	March 4.
Min. in shade	15°·8	16°·2
„ in the open	13°·7	12°·0
„ on grass	9°·6	8°·7

I have not yet had time to examine past records, but I believe it to be the lowest temperature in March since 1845. (Max. in screen on 2nd only 28°!) Snow on 3rd seven inches on the level, nearly the whole of which fell in the afternoon of the 2nd—a regular blizzard.

—*C. L. Prince*.

LANGTON HERRING, WEYMOUTH.—

March 3.—Min. temp. 21°, 9 a.m. 25°, 11 a.m. 27°, max. 32°
 4 „ „ 20° „ 25° „ 28°, 2.30 p.m. 32°

The minima of both days are lower than any previously recorded in March since January, 1881, and only once has a min. of 20° been recorded, viz., on February 25th, 1888. Solar halos were observed on both days.—*C. H. Gosset*.

SNOW STORM, MARCH 9TH.

To the Editor of the Meteorological Magazine.

SIR,—At 8.55 this morning, with a temperature of 32°, wind blowing from N.W. by N., snow of extreme fineness and dryness commenced to fall. The storm lasted till 9.5 a.m. I measured the depth in several places on a flat gravel walk not exposed to the wind, and found it to be exactly 1½ inches. I then measured the snow which had accumulated in the rim of my rain gauge, and it yielded .12 in. of water, being practically one-twelfth part. The snow rapidly disappeared in the hot sunshine which followed the storm.

JAS. WATKINS.

Hurst Bank, Heaton, Bolton, March 7th, 1890.

[Old readers of this magazine may be amused at the above in illustration of some articles in our early numbers on “Periodic Snowballs on March 8th.” On March 8th, this year, we had snow, hail and thunder in South Yorkshire, and there were several slight showers of soft hail and of snow in London on the 9th.—Ed.]

SALT IN HAIL.

To the Editor of the Meteorological Magazine.

SIR,—Some years ago, in the course of a search for traces of Krakatoa dust in the atmosphere, examining microscopically the spot on a slip of glass where a hailstone had melted and dried up, I found a few minute crystals of chloride of sodium.

GEORGE F. BURDER, M.D.

Clifton, February 28th, 1890.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on February 19th at the Institution of Civil Engineers, 25, Great George Street, Westminster.

Mr. O. B. Cuviljé, Mr. W. Harpur, M.Inst. C.E., and Mr. H. J. Spooner, F.G.S., were elected Fellows of the Society.

The following papers were read, viz. :—

1. "Observations on the Motion of Dust, as Illustrative of the Circulation of the Atmosphere, and of the Development of Certain Cloud Forms," by the Hon. Ralph Abercromby, F.R.Met.Soc. The author has made numerous observations on the motion of dust in various parts of the world, especially on the deserts on the West Coast of South America. He finds that the wind sometimes blows dust into streaks or lines, which are analogous to fibrous or hairy cirrus clouds; sometimes into transverse ridges and furrows, like solid waves, which are analogous to certain kinds of fleecy cirro-cumulus cloud; sometimes into crescent-shaped heaps with their convex side to the wind, which are perhaps analogous to a rare cloud form called "mackerel scales;" sometimes into whirlwinds, of at least two, if not of three, varieties, all of which present some analogies to atmospheric cyclones; sometimes into simple rising clouds, without any rotation, which are analogous to simple cumulus-topped squalls; and sometimes into forms intermediate between the whirlwind and simple rising cloud, some of which reproduce in a remarkable manner the combination of rounded, flat, and hairy clouds that are built up over certain types of squalls and showers. Excessive heating of the soil alone does not generate whirlwinds; they require a certain amount of wind from other causes to be moving at the time. The general conclusion is that when the air is in more or less rapid motion from cyclonic or other causes, small eddies of various kinds are formed, and that they develop the different sorts of gusts, showers, squalls, and whirlwinds.

2. "Cloud Nomenclature," by Captain D. Wilson-Barker, F.R.Met.Soc. The author proposes a simple division of cloud forms under two heads, viz., Cumulus and Stratus, and recommends that a more elaborate and complete division should be made of these two types. In support of this proposal photographs of clouds were exhibited on the screen.

3. "An Optical Feature of the Lightning Flash," by E. S. Bruce, M.A., F.R.Met.Soc. It has been stated in the Report of the Thunderstorm Committee of the Royal Meteorological Society that there is not the slightest evidence in the photographs of lightning flashes of the angular zigzag or forked forms commonly seen in pictures. The author, however, believes that this is an optical reality, as the clouds on which the projection of the flash is cast are often of the cumulus type, which afford an angular surface. In support of this theory he exhibited some lantern slides of lightning playing over clouds.

REMARKABLY DRY AIR.

To the Editor of the Meteorological Magazine.

SIR,—The following instances, observed here by myself, may be thought worthy of being added to your list :—

	Dry.	Wet.	Diff.	Humidity.
1870, July 24, 3 p.m.	89·7	63·8	25·9	23
1886, March 9, 5.45 p.m....	36·7	28·7	8·0	43

The readings were taken on an open stand (Glaisher's). The humidities were got from Glaisher's Hygrometric Tables, 2nd edition, the number 23 being approximate only, from defect of the table.

July 24th, 1870, was a day of intense heat (max. 91°·3), with a cloudless sky and a fresh breeze, varying between south-east and east.

March 9th, 1886, was very fine, but cold, with a gale from south-east, inclining at times towards south.

In my experience it has always been the case that extreme dryness of air has been associated with considerable strength of wind, and thus the question is raised as to how far the calculated relative humidity can be relied on for indicating that which it professes to indicate. It may even be a question whether, from some points of view, the bare difference between the dry and wet bulbs does not constitute a more valuable record than the calculated humidity. Certainly nothing can more accurately represent the *drying power* of the air, for the difference between the bulbs is the direct measure of the rapidity of evaporation.

The tables used by Col. Ward must, I think, differ materially from Glaisher's. At least, I cannot with Glaisher's tables bring out from Col. Ward's data humidities at all harmonising with those which he gives for his extreme instances.

GEORGE F. BURDER, M.D.

Clifton, February 28th, 1890.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—The late Dean Hook, who had a habit of soliloquizing aloud, being present at a service where the second lesson, which happened to be taken from the Epistle to the Hebrews, was given out by the reader as such a chapter from the Epistle of St. Paul to the Hebrews, said to himself, but in a voice that was quite audible to those near him, "So you have settled *that* question have you, old fellow?" The question alluded to by the Dean being of course, the much disputed one as to the authorship of the Epistle to the Hebrews.

I hope your correspondent, Dr. Muirhead, will not think me disrespectful if I say that a similar exclamation to that of the humorous Dean rose to my lips as I read his off-hand assertion that areas of

low pressure are areas "where the air is more rarified, and therefore lighter (not *depressed* as our meteorological authorities teach the general public day-by-day)."

Now this assertion of Dr. Muirhead's is probably true in regard to some of the minor inequalities of atmospheric pressure such as those to which he is chiefly referring in his letter, but, when made in the broad and sweeping way in which he has stated it in the words I have quoted, it seems to me to be a sheer paradox. Does he seriously maintain that the great gyrating low pressure systems which come to us from the Atlantic, *e.g.*, can be reasonably explained on any other theory than that of the existence of eddy like depressions in the atmospheric ocean?

Has he ever stood by the side of a stream and noticed the little "depressions" on the surface of the water where some obstacle to the even flow of the stream has given rise to a conflict of currents? And if so, has it not occurred to him that the conflict of the great atmospheric currents produced by the uneven distribution of the solar heat must inevitably give rise to similar eddy-like depressions in the atmosphere (cyclones) as well as to areas where the atmosphere is, so to speak, piled up (anticyclones). That, at any rate, appears to be the view taken by most leading meteorologists, and, though it may have its difficulties, is not to be set aside by a mere wave of the hand. If Dr. Muirhead will give us good and sufficient reasons for rejecting it, it must, of course, be abandoned; but at present it holds the field, and the burden of disproof lies with our opponents. I, for one, should like much to hear anything that can be fairly urged against it.

You, Sir, recently undertook to demonstrate the non-existence of thunderbolts, and in the opinion of most, if not all of your hearers, thoroughly succeeded in doing so. I am sure you will not deny to Dr. Muirhead the opportunity of demonstrating in your columns if he can, the non-existence of those atmospheric depressions which have so long haunted the too imaginative minds of Mr. Scott and his colleagues of the Meteorological Office.

G. T. RYVES, F.R. Met. Soc.

Team Vicarage, Stoke-on-Trent, March 6th, 1890.

REVIEWS.

Strathpeffer Spa, its climate and waters, with observations historical, medical, and general, descriptive of the vicinity. By FORTESCUE FOX, M.D. London, H. K. Lewis, 1889. 8vo. xviii., 166 pages, map and photo lithographs.

It is quite refreshing to have a new work on a British Health Resort. Some day we suppose it will become fashionable to be acquainted with the character, and beauty of our own country, and the time may come when people will believe that it is as possible to

find strong mineral water and pure air in the British Isles, as in France, Germany or Hungary.

Meanwhile Dr. Fortescue Fox has produced an interesting and useful monograph on the rising Spa of the far North—for it is very far North—a little N.W. of Inverness; but let it not be supposed that, therefore, Strathpeffer is a mere series of cottages on a hill side—the photographs show quite the contrary—but though there are four or five hotels, we should hardly recommend any one to follow Dr. Fox's advice, and take the 8 p.m. train from King's Cross, so as to reach Strathpeffer for lunch the next day, without *previously* ascertaining that there was a vacant room. Here, however, we have to deal only with the climate, and so we refer our readers for the history of the place, of the strength of its cold sulphur water, of the scenery, antiquities, &c., to the book itself, and proceed to epitomize the 20 pages or so devoted to its climate. This section is not written by Dr. Fortescue Fox, but by a relative to whom he refers as more "competent than myself." The first paragraph that we notice certainly does not justify praise, for either the writer wrote nonsense or the printer made nonsense of what he wrote, and the writer did not find it out. Here is the sentence :—

"Contrary to natural expectations, the Strathpeffer summer is much cooler than in the south of Britain, while, strange as it seems the average winter temperature is very little lower than that of the neighbourhood of London, and some of the winter months have even been slightly warmer."

The facts here are all right; but what do the first four words mean? Would any one naturally expect the summer to be hotter 400 miles nearer the Arctic circle than in London itself? Happily this is the only paragraph to which we need object, the bulk of the article is good, the writer hits the dominating influence when he says that the mountain ranges to the west extract much of the rain from the vapour laden westerly wind, thus giving Strathpeffer a dry and pleasant climate. That influence prevails from Perthshire, through the whole N.E. of Scotland, it is it which gives the crispness and brilliancy to the air of Braemar, and it is it partly which doubtless justifies the following paragraphs respecting Strathpeffer.

"The *Summers* are decidedly cooler than in the south of England, but they are bright, breezy and dry, especially in June and August. the long days invite to an open air life and vigorous exercise, which can be enjoyed without the enervating effect of the heat that is found so trying in many parts of England and on the continent. There is also the advantage of a pure ozoniferous mountain air."

"We have seen that the *Winters* are on the average a little colder than in the neighbourhood of London, but that the nights at least are often warmer. Moreover, the days are not spoiled by the fogs and mists so often met with in the south of England; and the rain clouds have a knack of clearing off readily, so that frequent spells of

sunshine, such as are hardly known in London, make walking a delight, even though the ground may be carpeted with crisp snow."

Dr. Fortescue Fox has been keeping careful meteorological records for four years, he has recently been adding to his instruments, and we believe so placing them that the results will be rigorously comparable with those at other stations, and we wish him success, not only in his meteorological, but in his medical work.

A popular treatise on the winds: comprising the general motions of the atmosphere, monsoons, cyclones, tornadoes, waterspouts, hailstorms, &c.

By W. FERREL, M.A. Ph. D. New York, Wiley & Sons; London, Trübner & Co., 1889. 8vo. viii.,—506 pages.

In writing this important work Prof. Ferrel has conferred a benefit on meteorologists. His mastery of mathematical methods is such that hitherto his publications have been beyond the comprehension of many, who would have profited by his instruction had it been conveyed in a manner which they could understand. The author has recognised this difficulty, and done his best to meet it. The result is a very valuable work treating fully all the subjects named in the title. Opinions will differ as to whether even now the title "popular" is strictly applicable, but however widely they may differ as to that, they will agree as to the value and importance of the information conveyed. And when Prof. Ferrel brings records of facts in illustration of his theories—no novelist or dramatist would compare with him for thrilling effect. Here for instance is one item in an account of a tornado:—

"At a farm house about 16 miles N.E. of Sunk Rapids, a wedding party of 30 persons was assembled, the ceremony was just concluded when the house was struck by the tornado. The bridegroom was killed outright, as were also 15 others; seven more victims of the catastrophe have since died, and only one of the company escaped severe injury."

Or take another case:—

"The house [probably of wood, Ed. *M.M.*] of Robert Reed, 16 ft. x 24 ft., and one-and-a-half stories high, was lifted up as easily as a feather, and without, at first, cracking the timber. So quickly was it done, that before Mr. Reed, who was within, knew his danger, the building had risen the height of 25 ft. or more. The house being then enveloped in darkness, and not knowing what had happened, he started for the door, thinking it time to make good his escape, when, instead of stepping out upon the ground as he expected, he fell the above distance, injuring himself severely."

But we must not let these thrilling stories lead us away from the main features of the book. It is very well arranged, starts with two introductory chapters (I.) On the Constitution and Nature of the Atmosphere, and (II.) on the Motions of bodies relative to the

earth's surface. The general circulation of the atmosphere is then considered, the influence of the earth's rotation and of the temperature of its surface being fully examined, as well as the influence of the circulation of the air on barometric pressure, rain and climate. Then follows consideration of monsoons, cyclones, and local winds, such as Pamperos, Mistral, Bora, &c.

Tornadoes receive a long chapter to themselves, and it is doubtful whether this could have been as well done by any one else. There are others, notably Lieut. Finley, who are more familiar with the damage, but we have never seen anything like the masterly way in which their mechanical effects are reduced to measurement, and shown to be in accordance with the known laws of matter. The study of tornadoes leads naturally to hail, thunder, and dust, storms, so that the book takes altogether a wide field.

As regards the formation of hail, while we have no serious objection to raise to the theory adopted by Prof. Ferrel, we think that some indication that his statements are theory and not facts, would have been an improvement. The subject is very difficult, many explanations have been suggested, and although very probably the theory given on p. 423 is correct, it is rather forcing the matter to put the whole process in the affirmative way there adopted.

Some persons find it difficult to believe that water ever falls on the earth in a solid stream, they say "Oh, no—you mean very heavy rain," but that is *not* what is meant. Even in this country we have heard the term "Cloud breaking," and "Breaking of a cloud," and Prof. Ferrel has a very interesting section on the subject, entitled "Cloud bursts," in which he adopts precisely the view we have always held as to the facts, and proceeds not merely to quote instances, but to show that theory is quite competent to explain how and why they happen.

The author uses all kinds of measures, English and metric haphazard, and frequently changes backwards and forwards in one sentence. Miles per hour into metres per second, Barometric gradients of English inches per English miles, suddenly given as millimetres and so on. No doubt it is perfectly clear to the author, but it would save trouble to those for whom the work is intended, if one series was adopted throughout. As regards temperatures, some are in Fahrenheit, some in Centigrade, and some are not marked either F. or C., so that one has to gather which they are by examining the context.

This, however, is the only fault that we have to find with a substantial and valuable work.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, AUGUST, 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	84.4	1	44.2	25	70.5	52.6	52.7	75	125.9	40.2	1.80	16	5.7
Malta	100.0	10	64.2	30	88.0	69.9	64.9	65	147.6	58.2	.00	0	0.3
Cape of Good Hope. ...	80.0	24	32.4	2	63.7	47.0	...	...	...	...	5.00	7	5.3
Mauritius	76.0	30	61.4	16	73.6	64.3	58.3	71	125.6	52.5	3.68	22	5.5
Calcutta.....	89.9	2, 4	74.4	8	87.2	78.3	79.0	88	155.7	74.6	8.03	27	7.9
Bombay.....	87.7	4	75.5	7	84.9	77.8	76.2	84	139.7	74.7	10.32	31	8.8
Ceylon, Colombo.....	87.0	17	73.4	31	85.0	77.9	72.3	78	143.1	72.0	4.66	14	7.3
Melbourne	68.0	28	32.1	3	57.8	43.0	42.3	75	127.3	23.4	2.06	15	6.1
Adelaide	71.3	28	38.0	23	60.2	46.0	45.1	74	128.3	29.2	3.59	20	5.1
Wellington	62.0	14	35.0	19	54.8	41.7	40.3	75	110.0	25.0	2.59	15	3.7
Auckland	62.5	24	40.0	19	57.9	46.6	46.0	80	133.0	30.0	2.59	18	6.0
Jamaica, Kingston.....	93.5	4	69.3	10	91.1	72.1	71.9	72	...	...	2.02	...	...
Trinidad	91.0	8	70.0	var.	89.8	71.3	77.9	81	158.0	61.0	11.73	24	...
Toronto	83.9	21	45.8	6	75.4	56.1	56.3	74	...	39.0	.43	10	5.2
New Brunswick, Frederickton	84.7	30	43.0	14	74.5	54.4	57.1	76	...	...	1.82	12	4.9
Manitoba, Winnipeg ...	96.6	30	33.8	4	80.3	50.8	56.1	71	...	...	.95	10	5.4
British Columbia, Victoria.....	77.0	11	41.0	20	69.0	48.3	...	...	...	...	1.04	6	...

REMARKS, AUGUST, 1889.

MALTA.—Mean temp. $77^{\circ} \cdot 9$; mean hourly velocity of wind 6.9 miles. The sea temp. fell from $79^{\circ} \cdot 5$ to $77^{\circ} \cdot 0$. Average amount of cloud unusually low. J. SCOLES.

Mauritius.—Mean temp. of air $0^{\circ} \cdot 4$, and of dew point $0^{\circ} \cdot 8$ below, E 1.61 in. above, their respective averages. Mean hourly velocity of wind 13.0 miles, or 0.6 miles above average; extremes 27.2 on 20th, and 1.6 on 8th. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air $0^{\circ} \cdot 2$ below, of dew point $0^{\circ} \cdot 2$ above, humidity 1 above, and E .23 in. above average. Prevailing winds N., strong on 8 days. Heavy dews on 10 days; fogs on 5 days; hoar frost on 2 days; hail on 2 days; T and L on the 11th. R. L. J. ELLERY, F.R.S.

Adelaide.—Pressure about normal. Mean temp. $0^{\circ} \cdot 9$ below the average. E 1.25 in. above the average, bringing the total for the year up to 23.32 in., the greatest on record during that period, and 1.03 in. above the total for the first 8 months of 1875, the previous highest record. C. TODD, F.R.S.

Wellington.—Heavy R on 3rd (1.15 in.), otherwise fine up to the 8th; from 9th to 18th generally showery; from 19th to the end pleasant weather, except on the night of 22nd, which was wet, with strong N.W. wind. Prevailing wind N.W., strong on 5 days. T on 14th, H on 14th. R half the average; mean temp. $0^{\circ} \cdot 3$ above average. R. B. GORE.

Auckland.—On the whole a fine, mild and seasonable month. Mean temp. the same as the average; E small, being $1\frac{1}{2}$ in. under the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 FEBRUARY, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	1.08	XI.	Castle Malgwyn	1.13
"	Margate, Birchington...	.88	"	Builth(Llanwrtyd Wells)	1.08
"	Littlehampton	1.36	"	Rhayader, Nantgwilt..	1.54
"	Hailsham	1.20	"	Carno, Tybrith	.59
"	Ryde, Thornbrough	1.08	"	Corwen, Rhng	.81
"	Alton, Ashdell	.67	"	I. of Man, Douglas	1.82
III.	Oxford, Magdalen Col...	.71	XII.	Stoneykirk, Ardwell Ho.	1.94
"	Banbury, Bloxham	.61	"	New Galloway, Glenlee	.97
"	Northampton	.72	"	Melrose, Abbey Gate...	.88
"	Cambridge (Fulbourne).	.82	XIII.	N. Esk Res. [Penicuik]	.90
"	Wisbech, Bank House..	.67	XIV.	Ballantrae, Glendrisaig	1.53
IV.	Southend	1.08	"	Glasgow, Queen's Park.	.50
"	Harlow, Sheering	.73	XV.	Islay, Gruinart School..	1.03
"	Rendlesham Hall	.82	XVI.	Dollar	1.11
"	Diss	1.06	"	Balquhiddie, Stronvar..	1.51
"	Swaffham	.68	"	Dunkeld, Inver Braan..	1.44
V.	Salisbury, Alderbury ...	.73	"	Dalnaspidal H.R.S.	2.07
"	Warminster	.87	"	Arbroath Cemetery	...
"	Bishop's Cannings	.73	XVII.	Keith H.R.S.	1.10
"	Ashburton, Holne Vic....	2.37	"	Forres H.R.S.	.40
"	Hatherleigh, Winsford.	.87	XVIII.	Fearn, Lower Pitkerrie.	.69
"	Lynmouth, Glenthorne.	1.26	"	Loch Shiel, Glenaladale	2.22
"	Probus, Lamellon	1.51	"	N. Uist. Loch Maddy ...	.40
"	Launceston, S. Petherwin	1.43	"	Invergarry	1.18
"	Wincanton, Stowell Rec.	.75	"	Aviemore H.R.S.	.45
"	Taunton, Lydeard Ho...	1.29	"	Loch Ness, Drumnadrochit	.58
"	Wells, Westbury	1.04	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	.58	"	Scourie	.89
"	Ross	.68	"	Watten H.R.S.	1.17
"	Wem, Clive Vicarage ...	.70	XX.	Dunmanway, Coolkelure	3.40
"	Cheadle, The Heath Ho.	.65	"	Fermoy, Gas Works ...	3.36
"	Worcester, Diglis Lock	.51	"	Tipperary, Henry Street	2.88
"	Coventry, Coundon	.71	"	Limerick, Kilcornan ...	...
VII.	Ketton Hall [Stamford]	1.10	"	Miltown Malbay	2.60
"	Grantham, Stainby	1.02	XXI.	Gorey, Courtown House	1.14
"	Horncastle, Bucknall ...	1.08	"	Navan, Balrath	.89
"	Mansfield	.80	"	Mullingar, Belvedere ..	1.05
VIII.	Neston, Hinderton	.65	"	Athlone, Twyford	1.02
"	Knutsford, Heathside ..	.64	"	Longford, Currygrane...	1.05
"	Lancaster, South Road.	.74	XXII.	Galway, Queen's Coll...	.95
"	Broughton-in-Furness ...	1.26	"	Clifden, Kylemore	2.18
IX.	Wakefield Prison	1.00	"	Crossmolina, Enniscoe..	.53
"	Ripon, Mickley	.98	"	Collooney, Markree Obs.	.46
"	Scarborough, West Bank	1.97	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	.99	XXIII.	Warrenpoint	1.71
"	Middleton, Mickleton ..	.88	"	Seaforde	1.66
X.	Haltwhistle, Unthank..	1.26	"	Belfast, New Barnsley..	1.53
"	Shap, Copy Hill	1.16	"	Bushmills, Dundarave...	1.05
XI.	Llanfrehfa Grange	.58	"	Stewartstown	1.38
"	Llandovery	1.06	"	Buncrana	1.03

FEBRUARY, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average, 1880-9	Greatest Fall in 24 hours.		Days on which 40 or more fall.	Max.		Min.		Finished.	On Grass.
				Dpth	Date.		Deg.	Date	Deg.	Date		
		Inches.	Inches.	In.								
I.	London (Camden Square) ...	1.05	— .83	.66	14	9	49.3	1	27.1	28	11	21
II.	Maidstone (Hunton Court)...	.92	— .88	.55	14	5	...	...	...	...	...	...
	Strathfield Turgiss	1.10	— .90	.61	14	8	50.7	18	24.8	4	15	24
III.	Hitchin	.73	— 1.02	.31	14	9	51.0	1	27.0	10	16	...
	Winslow (Addington)	.77	— 1.39	.34	15	8	50.0	1	24.0	13	14	20
IV.	Bury St. Edmunds (Westley) ..	1.02	— .54	.42	15	7	...	...	...	...	...	...
	Norwich (Cossey)	.64	— .95	.26	14	5	...	...	...	...	...	...
V.	Weymouth (Langton Herring) ..	.76	— 1.84	.17	14	7	50.0	17	26.0	28	13	...
"	Barnstaple	1.02	— 2.04	.31	19	7	53.0	22	26.0	3, 4	...	...
	Bodmin (Fore Street)	1.71	— 3.28	1.20	16	10	...	...	...	...	...	...
VI.	Stroud (Upfield)	.68	— 1.87	.22	15	6	50.0	1	25.0	12	15	...
"	Churchstretton (Woolstaston) ..	.84	— 1.61	.28	14	12	50.0	21	24.0	13	16	22
"	Tenbury (Orleton)	.74	— 1.74	.20	15	12	53.0	25	22.2	11	16	19
VII.	Leicester (Barkby)	.84	...	.44	15	11	51.0	1	21.0	5	19	27
"	Boston	1.15	— .53	.65	15	9	55.0	23	24.0	28	12	...
"	Hesley Hall [Tickhill]	.85	— .64	.60	15	11	52.0	1	23.0	11	12	...
VIII.	Manchester (Plymouth Grove) ..	.80	— 1.75	.15	15	6	51.0	1	27.0	5, 6	13	19
IX.	Wetherby (Ribston Hall) ...	1.13	— .45	.72	16	6	...	...	...	...	...	...
"	Skipton (Arncliffe)	1.15	— 3.54	.47	15	11	51.0	1	29.0	9	...	...
"	Hull (People's Park)	1.29	— .51	.65	15	11	...	...	...	...	...	...
X.	North Shields	1.51	+ .18	.60	15	13	54.0	1	28.0	6, 14	7	12
	Borrowdale (Seathwaite)	3.74	— 8.89	1.74	1	9	...	...	...	...	...	...
XI.	Cardiff (Ely)	.62	— 2.57	.23	19	8	...	...	...	...	...	...
"	Haverfordwest	1.50	— 2.62	.80	16	7	49.5	25	23.9	6	14	22
"	Plinlimmon (Cwmsymlog) ...	.68	...	.33	19	5	...	...	...	...	...	...
"	Llandudno	1.13	— .79	.32	15	5	49.1	1	29.0	13	...	...
XII.	Cargen [Dumfries]	1.00	— 2.65	.44	1	5	50.8	25	23.6	9	13	...
"	Jedburgh (Sunnyside)	.80	— .71	.38	15	6	50.0	23	20.0	9	16	...
XIV.	Old Cumnock	1.05	— 2.45	.47	1	8	51.0	23	18.0	27	20	...
XV.	Lochgilphed (Kilmory)	1.23	— 3.96	.40	1	10	...	...	...	...	...	...
"	Oban (Craigvarren)	.90	...	.31	1	11	52.2	24	29.0	28	2	...
"	Mull (Quinish)	1.05	— 4.42	.23	1	10	...	...	...	...	...	...
XVI.	Loch Leven Sluices	1.10	— 1.65	.60	16	4	...	...	...	...	...	...
"	Dundee (Eastern Necropolis) ..	1.35	— .75	1.00	15	4	51.6	24	25.9	8	16	...
XVII.	Braemar	1.38	— 1.98	.51	15	9	49.5	25	11.8	15	22	26
"	Aberdeen (Cranford)	1.01	...	.48	15	14	52.0	3, 23	28.0	14	9	...
XVIII.	Strome Ferry	1.30	— 4.43	.40	28	8	...	...	...	...	...	...
"	Culloden	.53	— 1.31	...	...	...	52.0	23	23.0	15	10	24
XIX.	Dunrobin	1.45	— .64	.48	15	6	55.0	23	27.8	8, 15	11	...
"	S. Ronaldsay (Roeberry)	1.37	— 1.27	.29	15	18	48.0	23	29.0	27	3	...
XX.	Cork (Blackrock)	2.56	— 2.51	.69	12	12	55.0	20	27.0	5	9	...
"	Dromore Castle	3.39	— 2.26	1.00	12	12	55.0	22	30.0	4	...	...
"	Waterford (Brook Lodge) ...	...	...	...	...	...	...	...	...	...	...	...
"	O'Briensbridge (Ross)	...	...	...	...	...	...	...	...	...	...	...
XXI.	Carlow (Browne's Hill)	1.21	— 1.87	.20	16	11	...	...	...	...	...	...
"	Dublin (Fitz William Square) ..	.80	— 1.55	.28	16	7	52.5	1	27.9	16	5	18
XXII.	Ballinasloe	.68	— 2.09	.18	1, 16	12	50.0	22	23.0	8	17	...
XXIII.	Waringstown	1.53	— .92	.42	19	11	56.0	22	25.0	4	12	21
"	Londonderry (Creggan Res.) ..	.76	— 2.28	.12	17	16	...	...	...	...	...	...
"	Omagh (Edenfel)	1.04	— 1.65	.21	17	11	50.0	2	27.0	4	7	22

a And 17. b And 26. c And 27, 28. d And 27. e And 28

+ Shows that the fall was above the average ; — that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The early part of the month was marked by a beneficial change, the weather being fine and dry, with a lower temperature. This colder weather continued throughout the month, and ended with a mean temp. on grass of $11^{\circ}8$.

ADDINGTON.—A very dry month. During 20 years a smaller quantity of R has been recorded in February only twice, namely, '63 in. in 1886, and '64 in. in 1887. Frost occurred on a good many days, but was not severe. On the mornings of the 21st and 22nd rather dense fog occurred, clearing off before midday. Winds easterly nearly all through the month.

BURY ST. EDMUNDS, WESTLEY.—The month was a dry one. The mildest day was the 1st, the coldest the 28th. N. and E. winds prevailed for 24 days.

LANGTON HERRING.—A very fine, dry, cold, month, presenting a striking contrast to January. The mean temp. at 9 a.m. was $3^{\circ}1$ below the average. Only once in February did the temp. rise above 49° —in January 17 times. Wind from W. on 4 days, E. on 24 days. Solar halo on the 14th. Fog on 21st and 22nd.

BODMIN, FORD STREET.—A dry month, with cold winds from N.E. and N.W., chiefly from E. and N.N.E. Hard frost on 28th, and freezing all day.

WOOLSTASTON.—A cold, dry month, with constant frost. S on 14th, 15th, 19th and 28th. Mean temp. $35^{\circ}7$. A very marked solar halo was observed in the afternoon of the 28th from about 4.40 to 5 p.m.; the prismatic tints were very bright, and the mock sun on either side well defined; the upper one was only faintly indicated, and the lower one (if any) was below the horizon. There was also a very fine lunar halo the same evening.

ORLETON.—A very dry, cold and dull month, with a prevailing wind from N.E. Frequent severe frosts at night, with much fog. The sun was generally obscured by clouds or fog, but there were a few bright days. The mean temp. of the month was $3^{\circ}7$ below the average of 29 years. The ground was only once covered with S, on the morning of the 20th. The bar. was very high during the greater part of the month. On the 24th at 5 p.m. great darkness with yellow fog occurred for half-an-hour, and again at the same hour on the 26th, with dark, stormy clouds. A lunar halo occurred on the night of the 28th, followed by a little S.

MANCHESTER, PLYMOUTH GROVE.—Thick fog on 6th; wet mist and thick fog on the 22nd, 23rd and 24th. S and sleet on the 20th. Cold E. wind prevailed. Mean temp. $38^{\circ}3$.

HULL.—The weather up to the 24th was generally fine, but with a great amount of cloud, from that date to the end of the month it was frequently squally with showers of R, H, or S.

WALES.

HAVERFORDWEST.—Showery and cold on 1st, from the 2nd to the 15th dry, fine, and frosty, with keen easterly wind; more like March than February. The weather changed rather suddenly on the 15th, and some heavy R occurred, followed by a return of cold, but somewhat broken weather, which continued to the end of the month. The temp. was below the average, and the number of fine days above the average. Prevailing winds E., S.E. and N.W.

SCOTLAND.

CARGEN.—The mean bar. pressure for the month (30.186 in.) was unusually high, and during the last 20 years has been exceeded only three times, viz., in

January, 1880, when it was 30·234 in. ; in November, 1879, 30·291 in. ; and in November, 1867, 30·189 in. The mean temp. of the month (37°·9) was 1°·7 below the average, and 4°·1 below that of January. E. winds prevailed on 20 days.

JEDBURGH.—The temperature was much lower than in January, with cold E., N., and N.E. winds. Vegetation has progressed little since January.

OBAN, CRAIGVARREN.—The month was quite exceptionally dry for February, and March winds commenced on the 11th and continued throughout with a cold spell at the end. Fruit and other trees commenced to leaf and spring flowers were in bloom.

CULLODEN.—The rainfall was very small. Many days were mild and very sunny and the frosts were moderate.

IRELAND.

CORK.—Generally cold with frequent showers to the 21st ; thence fine and often bright, with chilly easterly winds. Mean temp. 41°·8, nearly 0°·5 below the average.

DUBLIN.—This month was remarkable for the contrast it afforded to January. S.E. and E. winds, quiet, chiefly fine weather, frequent fogs, and low temp. took the place of the blustering S.W. gales, heavy and frequent rains, and high unsteady temp. of the preceding month. The mean temp. was 3° below that of January. The month may be regarded as a favourable one, but the amount of cloud (7·2) was much in excess of the average (6·6), and the month was notable for its foggy character. The mean temp. was 41°·5, or 1°·2 below the average. 8 or sleet fell on 13th and 28th. H on 7th ; fog on 10 days ; high winds on 6 days ; gale on 12th. Temp. in shade exceeded 50° on 2 days, and on 2 days did not rise above 40°.

OMAGH, EDENFEL.—A fine, generally dry, and seasonable month, with typical easterly winds prevailing on 20 days and with neither frost nor rain sufficient to interrupt its excellent character for farming operations.

THE WEATHER PLANT—GREAT RAINFALL

To the Editor of the Meteorological Magazine.

SIR,—I have seen in your last number that a weather plant has been fixed as weather prophet at the tourists' house on the Sonnblick (!) I was never able to ascertain if it performed, but I believe that the whole is nothing but humbug. I know nobody who can give me reliable information about it. The weather plant has lost all interest with us, and I hear nothing about it.

In the February number of the *Zeitschrift* you will find that at the station Hermsburg (about 3,000 ft. above sea level) in the south Krain, southern foot of the Krainer snow mountains, in the month of October 1889, 1450 mm. or 57·1 inches of rain fell. In one of our early numbers I shall report details about our new stations, where rain has been most plentiful. In South Dalmatia, Bocche di Cattaro we have a station, Crkvice, 3,445 ft. above sea level where in the year 1889, more than 5,000 mm. or 200 inches of rain fell, and yet the year has been pretty normal.

Yours very truly,

J. HANN.

Hohe Warte bei Wien, 22nd February, 1890.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCXCI.]

APRIL, 1890.

PRICE FOURPENCE,
[or 5s. per ann. post free.]

BIBLIOGRAPHY OF METEOROLOGY.*

To most of our readers the last paragraph of the introduction to the second volume of the type-written edition of the "Bibliography of Meteorology" will prove a sad disappointment. It is as follows:—

"It will be impracticable for this office to put forth any other part of this Bibliography; but possibly supplements to the subject of Part I., 'Temperature,' and Part II., 'Moisture,' may appear later."

That is to say, out of 32 sections and sub-sections two have been type-written, and the other 30 remain in manuscript in the library of the Signal Office.

We refuse to believe that a nation, wealthy and liberal in the highest degree, would consciously do so mean an action as first to invite the help of other countries in compiling a Bibliography, and by its responsible officer promise to publish it, and then, when it had received help from all quarters of the world, decline to carry out its promise, and keep the material so obtained for the use of its own officers.

We blame no one. It is the system, not any one man, who is in fault. We do not like putting ourselves in front, but we gave up something like a year of our own time towards preparing our share of that catalogue; the Royal Meteorological Society and the Royal Observatory, Greenwich, lent their MS. catalogues, and the Société Météorologique de France engaged a special assistant for many months to form a complete catalogue of its library, and sent it to England to be incorporated with the others, and for all this trouble and expenditure the result is—next to nothing.

Our readers will naturally ask—why? Because by the rules laid down, the Signal Office is not allowed to print such a work without

* *Bibliography of Meteorology*, prepared under the direction of Brigadier-General Greeley. Edited by Oliver L. Fassig, Bibliographer and Librarian to the Signal Office. Part II., "Moisture." Signal Office, Washington, 1889. 4to. Type-written, 478 pages.

the authority of Congress. General Hazen, when he promised to publish the Bibliography, never dreamed of there being any difficulty, but his successor, General Greely, although very desirous that it should be published, cannot break the laws which regulate his office. He has reported over and over again that it is desirable that it should be done, but a special vote by Congress is necessary, and we fear that few members of Congress are aware of the merits of the case.

It is really not a matter for which Europeans ought to plead strongly; it is for our friends in the States to examine the facts and act as they think worthy of their country. We are sure that if American scientists were once in possession of the merits of the question, they would soon lay the facts before the members of Congress, and that as soon as the members understood it all difficulty would be removed.

We could fill pages with resolutions and quotations from France, Germany, Belgium, and England, urging the importance of the publication, but we prefer to leave it entirely on its merits and entirely in the hands of our friends in the States.

We shall not refer to the subject again until we hear that the matter has been brought distinctly and definitely before Congress.

Turning now to Part II., we desire, in the first place, to record our appreciation of the immense labour which has been bestowed upon it in the Signal Office.

In the introduction General Greely intimates surprise or regret at the few errata and additions sent in with reference to Part I. Speaking only for ourselves, we not improbably speak for others also, when we say that the change from classification under authors to classification under subjects has thrown very great difficulties in the way of comparison and verification. The present part contains about 7,500 entries, and the only way by which we can check them is by cutting up two copies of the book (i.e., one for each side of each page) and arranging the 7,000 or 8,000 slips alphabetically under authors, and not till that is done can the checking against our books and pamphlets be begun. Obviously it would take much less time to do this for all sections at once than to do it separately 32 times over. It would at the very least take one person a twelve-month to check the whole Bibliography, and hitherto we have not had such encouragement as to induce this further expenditure of time.

Even as it stands in its imperfect typography this is a wonderful book, but rather saddening on the whole, for it shows so plainly how much work has been done in duplicate. It shows how needful it is that we should have that for which we have so often pleaded in these pages, "more hard workers, more deep thinkers"; but in this world most men have to earn a livelihood, and there is a serious

mistake current with those who have money, they always want to "see something for it." They are ready enough to pay for instruments and apparatus, or for making observations, but if one man proposed to work up the subject of the composition of rain-water, and as a preliminary to devote his time to a thorough mastery of what has already been done, whereas another proposed to buy a lot of apparatus and begin *de novo*, ignoring the past, the latter would be sure to be chosen.

When one looks through this volume one cannot but think how grand an advance would be made were the mass of knowledge which is indexed in the whole Bibliography worked up by competent hands, and abstracted from the 30,000 or 40,000 volumes into 40 or 50. One cannot but believe that the present system, whereby nearly all Government money is spent, is correctly described by the words applied to it by Sir George Airy many many years ago: "Adding millions of useless observations to the millions which already exist." The popular saying that "Half the world does not know how the other half lives," is equally true of meteorologists; half of them do not know what the other half have done. This Bibliography, completed and worked up as above suggested, would annihilate this difficulty, and place the rising generation of meteorologists in a position analogous to that conferred on astronomers by the splendid work of Houzeau and Lancaster.

PRE-INSTRUMENTAL METEOROLOGY.*

If one wishes to succeed, the prime necessity is perseverance. Twenty one years since we inserted in this Magazine, a letter under the above title, in which a scheme was formulated for collecting and preserving the many notes as to weather, frosts, floods and other remarkable phenomena which are recorded in early literature, and in the county histories and parish registers in the British Isles. Nobody has ever disputed the desirability of this being done, but on the other hand nobody except Miss E. A. Ormerod, F.R.Met.Soc. has ever done anything towards it. She with her habitual energy and perseverance took up the idea, and as the result we have in the library of the Royal Meteorological Society, the MS. volume entitled, "Pre-instrumental Meteorology, contained in extracts from the Saxon Chronicle and Holinshed's Chronicles of England, Scotland and Ireland." But Miss Ormerod has other work on hand. Is there no one else who combines a taste for meteorology with one for archæology, and who has also a few hours a week that they could give to it? We should enjoy it ourselves, but are over-worked already, and therefore, dare not undertake to do more than to help any one, or all, who will take it up.

* *Meteorological Magazine*, Vol. iv. (1869) p. 38; xii. (1877) p. 179; xiii. 1878) p. 6, and xx. (1885) p. 160.

As the above references show, we have persistently tried to find a labourer for this field, we are sure that he (or she) would reap a good harvest, and we believe that a notice in some of the leading literary journals, that a centre existed where such notices would be acceptable would bring in much information with little trouble.

Just as an illustration we may refer to the *Athenæum* of March 29th, 1890, where, in a review of *The Register Booke of Inglebye juxta Greenhow, since the yeare of our Lord, 1539*. Edited by John Blackburne, Curate, we find the following:—

“It has been suggested more than once that if the information were brought together a considerable amount of weather knowledge might be gleaned from old parish registers. An instance of this kind occurs under March 14th, 1666, when we find that a widow called Anna Bland ‘tempestate venti, nivis et frigoris extincta.’”

Is it too much to ask that those of our readers who are Clergy of the Church of England, and as such, custodians of the records of probably 100 or 200 parishes, shall each examine the records which he has and copy out all references to frosts, snows, storms, floods and other meteorological phenomena? Failing any better mode of publication, we are ready to insert them in these pages.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on February the 19th at the Institution of Civil Engineers, 25, Great George Street, Westminster; Mr. H. F. Blanford, F.R.S., vice-president, in the chair.

Mr. D. Balfour, M.Inst.C.E., Mr. W. Belk, M.Inst.C.E., Capt. G. A. Chaddock, Mr. W. S. Crimp, Assoc.M.Inst.C.E., Mr. G. Fellows, Dr. A. E. Garrod, M.A., M.R.C.P., and Capt. H. E. Rawson, R.E., were elected Fellows of the Society.

The following papers were read:—

1. “A Brief Notice respecting Photography in relation to Meteorological Work,” by Mr. G. M. Whipple, B.Sc., F.R.A.S. The first person to use photography for obtaining meteorological records was Mr. T. B. Jordan, of Falmouth, in 1838. Some years later, Sir F. Ronalds and Mr. C. Brooke devised more complete and elaborate apparatus; the arrangement of the former being now in use at the observatories of the Meteorological Office, and that of the latter at the Royal Observatory, Greenwich. Reference was also made to Mr. J. B. Jordan’s form of sunshine-recorder, and to Capt. Abney’s photo-nephograph. The various photographic processes which have been employed in connection with these instruments were fully described.

2. “Application of Photography to Meteorological Phenomena,” by Mr. W. Marriott, F.R.Met.Soc. The author showed how photography could be most usefully employed for the advancement

of meteorological knowledge. Much valuable information had been recently obtained from photographs of lightning and clouds. An interesting collection of such photographs was shown on the screen, together with others illustrating floods, whirlwinds, tornados, hail-storms, frost, snow, &c.

After the reading of these papers the meeting was adjourned to allow the Fellows to inspect the Exhibition of Instruments, &c., illustrating the application of photography to meteorology. Not only were specimens or drawings of nearly every photographic meteorological instrument and records from the same shown, but also a most valuable and interesting collection of photographs of clouds and other meteorological phenomena. The photographs of clouds taken by Mons. P. Garnier, of Boulogne-sur-Seine, were exceptionally fine. New meteorological instruments were also shown, as well as an ingenious working model, devised by Mr. A. W. Clayden for showing the connection between the monsoons and the currents of the Arabian Sea and the Bay of Bengal.

WHIRLWIND AT FULFORD, NEAR YORK, MARCH 8TH.

A very sudden and severe storm prevailed in the vicinity of York at about half-past two on Saturday afternoon. The sky rapidly darkened and vivid flashes of forked lightning were followed by loud peals of thunder and a heavy downfall of hail and rain. The storm was of short duration, and soon after three o'clock the sun again broke out and fine weather was experienced for awhile. Sudden gusts and showers took place at intervals. The storm seems to have touched the city lightly as compared with the devastation it created at Fulford. About half-past three a whirlwind of extraordinary violence visited Fulford, and the damage which it wrought in a short space of time is, at the lowest computation, estimated to be £100. Fulford Hall, the residence of Captain Key, and the home farm immediately adjoining, occupied by Mr. Harrison, appear to have suffered most from the violence of the storm, which was only at its height for something like a minute, and was confined to an area of about 200 square yards. The gale completely rooted up, and carried several yards, a number of very large trees, both oak and elm, and some crows which had taken refuge in their branches, were killed, the birds in some instances being dashed to pieces. A Dutch barn which is of about 96 feet in length, on Mr. Harrison's farm, was blown entirely from its foundations, carried over a hedge, and finally deposited 5 or 6 yards on the other side of the fence. Half a dozen large stacks were overturned, and some other stacks a short distance away rocked to and fro, and were all but upset. The windows of Fulford Hall bear testimony to the violence of the gale, and in some parts the slates have been torn off the roof, and other damage done. The roofs of the out-houses and dwellings in close proximity to Ful-

ford Hall have been damaged to a very great extent, whilst two bye lanes have been completely blocked by uprooted trees, hedges, and other *debris*. A notable fact is that some trees which stood just outside the area covered by the whirl-wind have scarcely been touched at all. A gentleman who witnessed the development of the whirl-wind says that it appears to have formed in the direction of Bishopthorpe, and after spending the worst of its violence at Fulford, it passed on to Heslington, where we understand considerable damage was done.—*York Herald*, March 10th, 1890.

[In order to avoid duplicate printing, this subject has been taken up by Mr. J. Edmund Clark, B.Sc., of York, whose account will be read at the meeting of the Royal Met. Soc., on April 16th, and subsequently printed in the *Quarterly Journal R. Met. Soc.*—ED.]

REVIEWS.

The Summary of a Meteorological Journal. Kept by C. LEESON PRINCE, F.R.A.S., F.R.Met.Soc., at his observatory, Crowborough, Sussex, 1889. Fcap. fol. Privately printed.

THERE are two special features in Mr. Prince's report for 1889. He draws attention to the great excess of N.E. winds in his records for the last few years. Abstracting his tables we have

			N.E.	S.W.	Excess of S.W.
Average frequency,	1843-89	47 years	63	91	+28
"	1859-83	25 "	63	99	+36
Frequency.....	1884		75	72	-3
Average frequency,	1885-89	5 "	102	72	-30

Mr. Prince very naturally remarks:—"It seems difficult to assign any physical cause for this sudden and great change in the direction of our two most prevalent winds, but it may be interesting to draw attention to the fact in the event of some comparative observations being elicited." We hope that some will be forthcoming, for it is a puzzle at present—unless indeed the large addition to Mr. Prince's house has affected the indication of his vane. Evidently the subject should be investigated in two ways—(1) by examining other records for the S.E. of England—(2) by Mr. Prince checking the indications of his vane by that of another, by low clouds, and by smoke.

The other fact which is certainly exceptional for this country, is one for which Mr. Prince gives the authority, viz., that "After the thunderstorm of June 7th, 1889, Mr. Young, of Barden Mill, Tunbridge Wells, picked up a hailstone weighing nearly or quite half-a-pound." The table in *Met.Mag.*, Vol. xiv., p. 116, shows that it must have been 3 inches in diameter, or $9\frac{1}{2}$ inches in circumference.

Berliner Zweigverein der Deutschen Meteorologischen Gesellschaft. Siebentes Vereinsjahr, 1890. Privately printed, Berlin, 1890.

WE refer to this paper because it contains two notes, which we desire to bring before our readers. Like all the previous reports

it is drawn up by Dr. Hellmann, and that gives weight to the statements.

(1). A thunderstorm occurred near Berlin, on May 16th, 1889, accompanied by what is described as a rain of "unusual intensity." Prof. Dr. Petersilie having measured 22.5 mm. (.89 in.) in 20 minutes between midnight and 0.22 a.m. on 16th. Dr. Hellmann says that no equally heavy rain had previously been recorded in Berlin, and he gives the nearest approach, the entries being—

Date.	Place.	Duration.	Amount.	Rate per hour.
1883, October 6...	Berlin.....	15 min. ...	.65 in. ...	2.60 in.
1889, May 16.....	Friedenau near Berlin	20 min. ...	.89 in. ...	2.67 in.

The rainfall of Berlin is not very much less than that of London (say 23½ in. against 26 in.) and yet these two rains are scarcely more than half what we have had in London, and are equalled or surpassed at dry English stations almost every year, as will be seen from the article on, "Heavy rains in short periods," in any recent volume of *British Rainfall*. Are our thunderstorms more intense than those of Berlin? Surely not, but perhaps equal electrical intensity occurring in a drier atmosphere cannot cause an equal volume of rain.

(2). Dr. Hellmann takes up the subject dealt with first by M. Lancaster, of Brussels, and investigated in the *Meteorological Magazine* for March, June and November, 1889, and gives the following interesting note:—

THE COLD PERIOD.

"The cold weather which has prevailed over West and Central Europe since the summer of 1885, has (with the exception of four months) continued throughout 1889, as is shown by the following table:—

Difference between the temperature at Berlin and the average.

	1885.	1886.	1887.	1888.	1889.
January	...	-0.2 ...	-3.8 ...	0.0 ...	-3.4
February	...	-8.1 ...	-1.3 ...	-6.1 ...	-4.5
March	...	-5.9 ...	-1.6 ...	-5.6 ...	-3.6
April	...	+1.8 ...	0.0 ...	-3.4 ...	+0.5
May	...	+1.8 ...	-2.2 ...	+0.5 ...	+10.8
June	...	-2.9 ...	-3.2 ...	-0.2 ...	+7.6
July	...	-1.8 ...	+1.8 ...	-4.1 ...	-1.3
August	-5.6 ...	+0.9 ...	-1.6 ...	-2.0 ...	-1.4
September	-2.5 ...	+3.2 ...	-0.9 ...	-0.4 ...	-4.1
October	-2.5 ...	0.0 ...	-4.9 ...	-2.5 ...	-0.4
November	-2.9 ...	+4.0 ...	+1.8 ...	+0.2 ...	+0.9
December	-0.4 ...	+1.3 ...	+0.4 ...	+2.0 ...	-1.1
Year	...	-0.5	-1.3	-1.3	0.0

"Therefore, May and June, 1889, were so remarkably warm as to neutralize all the deficiencies in the other months of that year. Since the commencement of observations in Berlin, in 1719, there is no case of a warmer May and June; 1756 is the only warmer June. The immediate sequence of two such hot months is very rare—probably hardly occurs once in a century."

Cyclones of Drought and Good Seasons in South Africa. By D. E. HUTCHINS, Conservator of Forests, Knysna, with Cyclical Diagrams. *Times Office, Wynberg, 1889.* London: W. Wesley and Son. Sm. 8vo., 137 pages, 4 plates.

THIS is a remarkable little book, a review of which could be more easily written in 1900 than in 1890, as the author is so sure that he has found a perfect rule as to South African rainfall, that he predicts the character of each year from 1889 to 1938 inclusive, not in a vague general way, but in detail, and not merely for the whole Colony, but for different districts in it.

The author's calculations are primarily based on sun-spot frequency, but he complains of the sun-spots as too irregular (though he occasionally uses them), and says that Wolf's average of 11.11 years is better, but we do not see where he states from what date he begins to take this 11.11, nor what becomes of the fractions which necessarily result from it. Then he has allowances for retardation, or lagging, of one, two or three years, and cycles of all sorts of lengths, *e.g.*, 9.5 years on p. 74, 9 or 10 years p. 78, and 12.7 or probably $12\frac{1}{2}$ years on p. 82. With such a variety one can of course explain anything, and we, therefore, leave his theories to the best possible test—that of the fulfilment of his predictions. We hope that they will be; we long to be able to bring to the notice of our readers some one who can win the blue riband of meteorology, and if the *Meteorological Magazine* is in existence in 1900, and we have any share in its direction, and Mr. Hutchins can bring up evidence of 10 years' success, we will do all in our power to ensure him the honour he will merit. But he must be careful; we are sure that it is accidental, not intentional, but on p. 125, he has taken 9.5 from 1831, and obtained $1822.5 = \text{July 1st, 1822}$, which is what is wanted to support the theory—evidently it should be 1821.5, which makes it one year wrong.

As regards the predictions, we leave them to the future; but we ought not to omit to say that the work contains abstracts of many long registers, and much useful and interesting matter.

NOT AN EARTHQUAKE.

THERE was a report that an earthquake was felt at several places near Chelmsford on January 7th, 1890, at 0.30 and at 1.25 p.m.

Mr. Davison, of Birmingham, is at present studying British earthquakes, and therefore devoted attention to this statement, and has finally proved, beyond all dispute, that it was a mistake, the real cause of the noise, vibration, &c., being the firing of charges from one of the great 110-ton guns at Woolwich.

We had not quoted the report in these pages, but, as errors are notoriously difficult to correct, we insert this note for the benefit of future investigators.

“AREAS OF RAREFACTION” OR “DEPRESSIONS.”

To the Editor of the Meteorological Magazine.

SIR,—In replying to the Rev. Mr. Ryves' letter (page 23), I take for granted that he, in common with every other F.R.Met.Soc. knows and acknowledges that the winds around a cyclone, however extensive, curve somewhat inwards towards the centre round which they whirl. That being so, the inblowing winds will tend to displace the more central portion. And as the latter cannot get downwards into the ground nor outwards into the in-pressing winds, these winds will eject it upwards and then as this process goes steadily on for days, each portion of the incurving air as it approximates near to the centre will be treated in the same fashion by the winds arriving later and get ejected upwards also. The large amount of air thus sent upwards will be forcibly compelled to go up and up till it surmounts the neighbouring anti-cyclone areas; over which it will flow, and possibly, some of it go down, there to renew the same course of action as before.

This being the only way in which the central air of a cyclone can be conceived to get ejected by the denser air around forcing its way inwards, I am unable to picture to myself the formation of a hollow cup-like depression facing skywards like that of a liquid whirlpool.

As to the liquid whirlpool, Mr. Ryves seems to forget that the water in the whirl is driven earthwards, not heavenwards as the air in the cyclone is. And it appears to me that if ever there be any cup-like hollow formed, at all, in the latter, it must be at the bottom of the atmosphere, and not at the top where he and the general public are given to place it.

I used the phrase “general public,” because I have been under the impression (how generated I know not) that the meteorological authorities in using the term “depression,” meant depression of the mercury in the barometer; but that the general public would naturally take it to mean a depression in the atmosphere. And now I find that my general public includes, at least, one F.R.Met.Soc.

In conclusion, I beg to thank Mr. Ryves for ventilating this subject, so that he, or I, or both of us may be put right.

HENRY MUIRHEAD, M.D.

Cambuslang, 19th March.

WHAT IS A DEPRESSION?

To the Editor of the Meteorological Magazine.

SIR,—Dr. Muirhead, in objecting to the use of the term “depression,” assumes that meteorologists mean by it a depression of the air, and Mr. Ryves, in criticising Dr. Muirhead's views, seems to adopt the same assumption. But is this quite correct?

In its origin, at all events, the term “depression” must surely have been used by meteorologists as an abbreviated form of

"barometric depression"—that is to say, a depression of the mercurial column in the barometer; and this, I suspect, is what the term still means to most persons, although when we read of a depression "deepening" or "filling up," we do, no doubt, picture to ourselves what we conceive to be the actual state of things in the upper regions of the atmosphere.

It may be that the theoretical idea which modern meteorology seems to have infused into the word "depression" has to some extent supplanted the original idea, but so long as depressions are measured by the height of the mercurial column it is hardly possible that the original idea of the word, which I take to have been simply descriptive, can be entirely lost.

GEORGE F. BURDER, M.D.

Clifton, March 19th, 1890.

SHOWER OF SOFT HAIL.

To the Editor of the Meteorological Magazine.

SIR,—A remarkable shower of soft hail occurred here shortly before 1 p.m. on Tuesday last (April 8th). The masses of hail (they were neither "stones" nor "balls") were of irregular shape, in some cases half an inch in diameter, and appeared to be made up of small plates of ice adhering like the petals of a double marigold. The last form, on melting, was an irregular disc of ice. A noticeable point was the facility with which the masses adhered on being brought into contact, so that by merely putting them together on a sheet of paper you could get a layer three inches or more in diameter. They must have been in a peculiarly favourable condition for regelation. The shower lasted only a few minutes. There was a little rain with it, a good deal of wind, and there were two claps of thunder. We had no more during the day, but one or two violent squalls in the afternoon. In these the sky became very dark, and a sort of dark mist came on, blurring the tree outlines as a slight Scotch mist would. In one of them I was on the top of the heath, and saw this dark mist sweeping down on the more or less distant landscape from the clouds, as the squall passed over it. I imagine that it was due to the rain-drops being broken up by the violent wind. But it was unusual, as was the soft hail squall described. All came from the north, or a little west of it.—Yours truly,

B. WOODD SMITH.

Branch Hill Lodge, Hampstead Heath, N.W., April 11th, 1890.

[At Camden Square the notes on the shower are as follows:—
"11 a.m.: Heavy shower of soft hail (apparently fragments of spheres), about half an inch in diameter; this lasted about five minutes. 0.50 p.m.: Three claps of thunder and some more soft hail, some of it nearly half an inch across, and very soft."—ED.]

MR. MARRIOTT ON THUNDERSTORMS.

To the Editor of the Meteorological Magazine.

SIR,—There seems to be something wrong about the statistics in the summary you give (vol. xxiv., p. 170) of Mr. Marriott's paper on "The Distribution of Thunderstorms. . . ." It states that thunderstorms are most numerous in the south of England, yet they are given as fewest for Middlesex. It looks as though no account has been taken of the number of observers in each district, which must be done if correct proportionate numbers of thunderstorms are to be arrived at.

T. W. BACKHOUSE.

Sunderland, February 19th, 1890.

FINE METEOR ON MARCH 21st.

To the Editor of the Meteorological Magazine.

SIR,—You may like to have an account of the splendid meteor seen by myself and many others last evening, about 9.5 p.m., to compare with other reports.

I was standing by my drive gate at that time when the road became illuminated suddenly, so that I could see every stone upon it.

Instantly looking up I saw an intensely bright meteor traverse a small portion of the sky between Ursa Major and Bootes, bursting in a shower of sparks near Arcturus.

After an interval of some three to four minutes a dull boom, more like the discharge of a piece of heavy artillery at twenty miles distance than what some people took it to be—a distant thunder peal, was distinctly heard. Whether this had any connection with the meteor I must leave to others.

I ought to say, that one man said he saw a flash of lightning in the S.W., a few minutes *afterwards*, which I did not observe, although from the low barometer, 29.2, I thought it was not improbable.

Yours very truly,

R. J. W. PURDY.

Woodgate House, Ayleham, March 22nd, 1890.

P.S. Two other persons I have just seen, who witnessed the sight declare that they heard a slight rustling sound when the meteor exploded, but I am inclined to believe that the rocket-like discharge of the body led them to imagine that they heard a sound such as usually accompanies pyrotechnic displays.

THE FROST OF THE FIRST WEEK OF MARCH.

Mr. C. HARDING, F.R.Met.Soc., having undertaken to prepare a paper upon this subject, developing and completing the notes given in our last, we refer our readers to the *Quar. Jour. R. Met. Soc.* for the full details.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPT., 1899.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0.100	°	°	inches		0.10
England, London	80·3	11	35·1	23	65·6	48·9	48·2	75	125·6	28·4	1·77	10	5·6
Malta	93·3	3	61·7	21	83·5	67·6	65·8	76	141·7	55·6	2·21	6	2·7
<i>Cape of Good Hope.</i> ...	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mauritius</i>	77·0	28 ^a	59·2	27	75·1	64·2	59·8	74	128·9	50·0	1·53	18	5·3
Calcutta	91·4	30	73·7	8	87·6	77·5	78·1	86	155·7	72·6	4·76	15	6·3
Bombay	89·5	22	75·9	2	87·1	78·2	76·4	82	145·8	71·9	2·71	13	7·0
Ceylon, Colombo	87·0	28	71·6	9	84·8	76·5	72·1	79	151·0	70·2	25·08	22	7·8
<i>Melbourne</i>	74·5	26	32·1	3	61·4	43·1	42·3	69	129·8	25·3	1·51	14	5·1
<i>Adelaide</i>	76·7	7	38·5	2	63·2	47·2	45·0	69	132·7	32·1	1·50	16	5·7
<i>Wellington</i>	65·5	26	39·0	1	59·6	46·6	46·3	77	130·0	28·0	4·78	17	4·0
<i>Auckland</i>	71·0	30	44·0	23	62·0	51·2	50·4	80	130·0	38·0	5·82	19	6·5
Jamaica, Kingston	93·4	29	68·2	24	90·5	72·7	74·0	79	...	...	4·55	...	...
Trinidad	92·0	26	63·0	11	88·0	70·0	73·1	79	157·0	58·0	3·76	20	...
Toronto	81·9	3	35·3	29	68·2	52·0	54·3	78	...	29·8	2·08	14	5·1
New Brunswick, Fredericton	85·7	2	24·9	30	71·6	49·7	55·4	78	...	...	2·52	10	7·8
Manitoba, Winnipeg ...	94·0	1	29·0	21	61·2	39·3	41·1	74	...	...	2·57	14	6·0
British Columbia, Victoria	73·0	6, 26	34·0	12	64·8	42·9	...	...	...	...	2·33	8	...

^a And 30.

REMARKS, SEPTEMBER, 1899.

MALTA.—Mean temp. 74°·3; mean hourly velocity of wind 5·9 miles. Sea temp. fell to 75°·5. TSS on 3 days, L on 4 days. J. SCOLES.

Mauritius.—Mean temp. of air 0°·9 below, dew point equal to, and E ·06 in. above, their respective averages. Mean hourly velocity of wind 11·4 miles, or 0·7 mile below average; extremes 25·4 on 19th, and 1·7 on 14th and 27th. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

CALCUTTA.—The south-west monsoon has been very light, most noticeable in the unusually light winds accompanying depressions forming in the bay. The B has not generally been below the average. C. LITTLE.

CEYLON, COLOMBO.—TS occurred on 6 days. J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 1°·0, of dew point 1°·3, humidity 2, amount of cloud 0·9, and E ·76 in. below the average. Prevailing wind N., strong on 9 days. Heavy dew on 9 days; hoar frost on 4 days; hail on the 1st. R. L. J. ELLERY, F.R.S.

Adelaide.—Rainfall slightly below the average of 32 years, but the total since January 1 is still in advance of any previous record. Pressure about, and temp. nearly 2° below, the mean. C. TODD, F.R.S.

Wellington.—Showery up to the 18th, with wind chiefly from N.W., and strong; from 19th to 24th fine pleasant weather, with light variable wind; from 25th to the end showery. Mean temp. 2°·2, and E ·52 in. above the average. R. B. GORE.

Auckland.—A stormy, wet, disagreeable month. Pressure close to the average of 22 years. Mean temp. 2° and E 2·50 in. above the average. F. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 MARCH, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	2.51	XI.	Castle Malgwyn	2.57
"	Margate, Birchington...	2.66	"	Builth(Llanwrtyd Wells)	4.31
"	Littlehampton	1.13	"	Rhayader, Nantgwillt...	4.58
"	Hailsham	2.07	"	Carno, Tybrith ...	3.37
"	Ryde, Thornbrough	1.29	"	Corwen, Rhug	2.15
"	Alton, Ashdell.....	1.93	"	I. of Man, Douglas	3.05
III.	Oxford, Magdalen Col...	.72	XII.	Stoneykirk, ArdwellHo.	1.89
"	Banbury, Bloxham	.99	"	New Galloway, Glenlee	3.87
"	Northampton	1.39	"	Melrose, Abbey Gate...	1.97
"	Cambridge, Fulbourne..	3.52	XIII.	N. Esk Res. [Penicuik]	3.75
"	Wisbech, Bank House..	2.34	XIV.	Ballantrae, Glendrisaig	2.78
IV.	Southend	1.70	"	Glasgow, Queen's Park.	2.41
"	Harlow, Sheering	1.52	XV.	Islay, Gruinart School..	3.67
"	Rendlesham Hall	2.56	XVI.	Dollar	2.58
"	Diss	3.18	"	Balquhider, Stronvar..	6.36
"	Swaffham	2.52	"	Dunkeld, Inver Braan..	2.89
V.	Salisbury, Alderbury ...	1.21	"	Dalnaspidal H.R.S. ...	6.57
"	Warminster	1.11	"	Arbroath Cemetery.....	..
"	Bishop's Cannings	1.26	XVII.	Keith H.R.S.	2.14
"	Ashburton, Holne Vic...	3.31	"	Forres H.R.S.	2.00
"	Hatherleigh, Winsford.	.39	XVIII.	Fearn, Lower Pitkerrie.	2.08
"	Lynmouth, Glenthorne.	1.74	"	Loch Shiel, Glenaladale	14.49
"	Probus, Lamellyn	1.97	"	N. Uist. Loch Maddy ...	5.21
"	Launceston, S. Petherwin	1.73	"	Invergarry	7.48
"	Wincanton, Stowell Rec.	1.66	"	Aviemore H.R.S.	3.24
"	Taunton, Lydeard Ho...	1.19	"	Loch Ness, Drumnadrochit	3.41
"	Wells, Westbury	1.54	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	1.11	"	Scourie	5.16
"	Ross	.91	"	Watten H.R.S.	2.01
"	Wem, Clive Vicarage ...	1.13	XX.	Dunmanway, Coolkelure	5.86
"	Cheadle, The Heath Ho.	1.53	"	Fermoy, Gas Works ...	3.91
"	Worcester, Diglis Lock	.92	"	Tipperary, Henry Street	3.88
"	Coventry, Coundon	1.64	"	Limerick, Kilcornan ...	2.16
VII.	Ketton Hall [Stamford]	2.23	"	Miltown Malbay.....	3.63
"	Grantham, Stainby	2.46	XXI.	Gorey, Courtown House	2.84
"	Horncastle, Bucknall ...	1.54	"	Navan, Balrath	2.85
"	Mansfield	...	"	Mullingar, Belvedere...	3.73
VIII.	Neston, Hinderton	1.50	"	Athlone, Twyford	3.57
"	Knutsford, Heathside ...	2.52	"	Longford, Currygrane ...	3.14
"	Lancaster, South Road.	4.21	XXII.	Galway, Queen's Coll...	2.64
"	Broughton-in-Furness ..	6.19	"	Clifden, Kylemore	3.53
IX.	Wakefield Prison	1.30	"	Crossmolina, Enniscoe..	3.82
"	Ripon, Mickley	2.47	"	Collooney, Markree Obs.	2.55
"	Scarborough, West Bank	1.96	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	1.69	XXIII.	Warrenpoint	3.59
"	Middleton, Mickleton..	2.71	"	Seaford	2.35
X.	Haltwhistle, Unthank...	3.02	"	Belfast, New Barnsley..	2.84
"	Shap, Copy Hill	2.99	"	Bushmills, Dundarave...	2.88
XI.	Llanfrechfa Grange	1.23	"	Stewartstown	2.38
"	Llandovery	3.82	"	Buncrana	2.47

MARCH, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Days on which '01 or more fell.	Max.		Min.		In shade.	On grass.	
				Dpth.	Date.		Deg.	Date.	Deg.	Date.			
I.	London (Camden Square) ...	1.76	+ .15	.48	19	14	66.2	28	15.6	4	7	15	
II.	Maidstone (Hunton Court)...	2.59	+ 1.09	1.29	19	15	...	...	...	...	...	...	
III.	Strathfield Turgiss	1.28	— .31	.27	24	19	64.1	29	13.8	4	10	21	
	Hitchin	2.52	+ 1.18	.93	19	13	62.0	28	15.0	3	6	...	
IV.	Winslow (Addington)	1.56	— .16	.36	19	16	62.0	28	14.0	4	12	18	
	Bury St. Edmunds (Westley) ...	3.17	+ 1.62	1.30	19	11	...	...	...	...	...	...	
V.	Norwich (Cossey)	2.79	+ 1.37	.68	19	16	...	...	...	...	...	...	
	Weymouth (Langton Herring) ...	1.02	— .88	.28	24	12	58.0	29	20.0	4	7	...	
VI.	Barnstaple	1.66	— .83	.43	21	10	59.0	31	18.0	4	...	...	
	Bodmin (Fore Street)	2.94	— .84	.62	24	17	...	...	...	...	...	...	
VII.	Stroud (Upfield)	.94	— 1.25	.23	24	13	63.0	27 ^b	19.0	3	6	...	
	Church Stretton (Woolstaston) ...	1.49	— .64	.32	16	19	59.5	28	21.0	3	8	15	
VIII.	Tenbury (Orleton)	1.57	— .51	.42	24	14	60.8	26	14.8	4	13	16	
	Leicester (Barkby)	2.12	+ .41	.84	19	21	65.0	23	12.0	3	11	22	
IX.	Boston	1.49	— .04	.82	22	10	64.0	22	19.0	4	9	...	
	Hesley Hall (Tickhill)	1.50	— .40	.45	19	10	63.0	28	21.0	4	11	...	
X.	Manchester (Plymouth Grove) ...	3.00	+ .78	.56	9	19	61.0	28	24.0	3	8	12	
XI.	Wetherby (Ribston Hall) ...	1.56	— .50	.62	20	7	...	...	...	...	...	...	
	Skipton (Arncliffe)	5.16	+ .06	.70	9	22	...	...	...	...	...	...	
XII.	Hull (People's Park)	1.57	— .48	.55	19	17	...	...	...	...	...	...	
	North Shields	1.91	— .52	.42	20 ^a	15	61.5	12 ^b	26.0	4	8	11	
XIII.	Borrowdale (Seathwaite)	12.73	+ 2.23	1.77	9	24	...	...	...	...	...	...	
	Cardiff (Ely)	1.75	— 1.23	.28	24	13	...	...	...	...	...	...	
XIV.	Haverfordwest	2.44	— .80	.68	24	11	55.0	30 ^d	18.3	3	6	14	
	Plinlimmon (Cwmsymlog) ...	4.89	...	.80	16	14	...	...	...	...	...	...	
XV.	Llandudno	1.71	— .37	.33	9	16	57.0	20	25.4	4	3	...	
	Cargen [Dumfries]	2.59	— .71	.46	28	17	56.8	10 ^e	22.6	3	7	...	
XVI.	Jedburgh (Sunnyside)	1.43	— .53	.40	20 ^b	12	59.0	16 ^f	25.0	5	9	...	
	Old Cumnock	3.07	— .06	.42	16	23	60.0	31	16.0	2	11	...	
XVII.	Lochgilphhead (Kilmory)	6.35	+ 1.89	1.31	15	24	...	...	...	...	...	...	
	Oban (Craigvarren)	7.38	...	1.35	15	26	53.0	28	27.0	9	5	...	
XVIII.	Mull (Quinish)	6.87	+ 3.03	1.40	15	25	...	...	...	...	...	...	
	Loch Leven Sluices	2.40	— .57	.50	9, 25	12	...	...	...	...	...	...	
XIX.	Dundee (Eastern Necropolis) ...	1.90	— .50	.65	24	9	59.3	11	21.9	9	7	...	
	Braemar	...	...	...	...	...	...	...	...	...	...	...	
XX.	Aberdeen (Cranford)	2.80	...	.77	20	19	61.0	12	22.0	8	9	...	
	Strome Ferry	6.94	+ 2.31	1.10	15	26	52.0	15 ^g	26.0	1	3	...	
XXI.	Culloden	2.57	+ 1.03	...	...	...	57.0	12	21.0	9	10	24	
	Dunrobin	4.78	+ 2.53	1.25	10	15	60.0	12 ^h	23.0	9	9	...	
XXII.	S. Ronaldsay (Roseberry)	...	...	...	...	...	...	...	...	...	...	...	
	Cork (Blackrock)	4.51	+ .95	1.87	15	17	63.0	22	28.0	16	8	...	
XXIII.	Dromore Castle	5.21	+ .79	.60	17 ^c	18	60.0	25	27.0	2	...	...	
	Waterford (Brook Lodge) ...	3.82	+ .92	1.40	15	18	60.0	11	25.0	4	12	...	
XXIV.	O'Briensbridge (Ross)	...	...	...	...	...	...	...	...	...	...	...	
	Carlow (Browne's Hill)	4.17	+ 1.80	1.34	15	18	...	...	...	...	...	...	
XXV.	Dublin (Fitz William Square) ...	3.69	+ 1.68	.98	24	17	59.6	12	31.2	3, 9	4	16	
	Ballinasloe	2.66	+ .03	.68	15	22	55.0	10	21.0	3	14	...	
XXVI.	Waringstown	2.64	+ .29	1.16	15	19	59.0	27	24.0	1, 2	15	16	
	Londonderry (Creggan Res.) ..	2.62	— .11	.91	15	22	...	...	...	...	...	...	
XXVII.	Omagh (Edenfel)	2.93	+ .42	.99	15	25	54.0	27	23.0	1	7	15	

a And 24. b And 28. c And 26. d And 31. e And 15. f And 29. g And 30, 31. h 14.

+ Shows that the fall was above the average ; — that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A fine, healthy month, with a sharp of frost on the 4th. Thus far, a very favourable season for vegetation of all kinds. Grass min. on 4th, 12°·4. Humble bee first seen on 15th; brimstone butterfly on 26th.

ADDINGTON.—The first four days of the month were very cold, but after the 4th, although occasional frosts occurred, they were not severe. The R, though in no great quantity, hindered work on heavy land.

BURY ST. EDMUNDS, WESTLEY.—March came in like a lion and went out like a lamb. This old saying has been very true this year. Casella's min. thermometer exposed 1 ft. from the ground registered on the 3rd, 3°; on the 4th, 6°; and on the 28th, in the shade, 61°. On the 19th, 1·30 in. of S and R fell, which caused great floods in Suffolk; spring sowing is very backward.

LANGTON HERRING.—Another dry month, the deficit for the month being 44 per cent. Notwithstanding the cold of the first four days, the temp. of the month was above the average for March for 18 years. The excess at 9 a.m. being 1°·5. The temp. on the nights of the 2nd and 3rd are the lowest recorded in March in 19 years. Solar halos were frequently observed; fogs prevailed on the 26th, 27th and 28th. The last three days of the month were very fine.

BODMIN, FORE STREET.—An exceptionally fine month. Hard frost on the 2nd, 3rd, and 4th, and frost also on 17th, 19th, 21st, and 30th. H on the 17th. Occasional high winds, very mild and fine, from 25th to 31st.

STROUD, UPFIELD.—Lunar rainbow on the 1st. Slight S on 1st and 9th.

ORLETON.—The month commenced with intense frost, the thermometer on the grass registering 11° on the 4th. The weather then changed and was warm and pleasant till the end of the month, with occasional sharp frosts. The mean temp. of the month was 2°·8 above the average of the last 29 years. Snow on the 1st, 3rd, 4th, and 9th; distant T on the 17th. Damson and plum trees beginning to come out on the 26th; willow wren heard on the 29th.

WOOLSTASTON.—The month opened with severe frost, and S fell heavily on the 8th. The remainder of the month was very seasonable. Mean temp. 42°·7.

MANCHESTER, PLYMOUTH GROVE.—S fell on the 1st and 2nd, and a severe S storm occurred on the 9th, commencing at 9 a.m. and lasting about an hour. The first nine days were cold and winterly. E. winds blew on 8 days; W. on 23 days. Fine, bright, and sunny on 12th, 16th, 17th, 22nd, 26th, 29th, 30th, and 31st. Mean temp. 44°·5.

HULL.—The weather during the month was nearly equally divided between fine and showery days. Generally the falls of R were not heavy, or of long duration, leaving longer periods of fine weather than is usual with such a number of days on which R fell.

WALES.

HAVERFORDWEST.—The month commenced with fine, but very cold, weather, severe N.E. winds prevailing and sharp frost, the min. on 3rd being the lowest in March since 1886; the mean temp. of the day was 26°·5; on the grass the temp. fell to 8°. This wave of cold was, however, evanescent, the temp. rising rapidly, and the rest of the month was warmer than the average. Strong westerly winds, at times reaching the force of a gale, prevailed about the 7th and 8th, 14th and 15th. A stormy, wet period from the 22nd to 24th. Prevailing winds W.N.W. and S.W.

SCOTLAND.

CARGEN.—The mean temp. of the month ($48^{\circ}1$) was $2^{\circ}4$ above the average. Sunshine somewhat below the average. Vegetation generally very advanced; many flowering shrubs, rhododendrons, &c., in bloom at least a month earlier than usual. S on 8th, T on 16th at 1 p.m.

JEDBURGH.—Though cold and ungenial, the month on the whole was fine. The land was in fine order, and it is rarely that the seed gets such a dry bed. Vegetation progressed steadily.

CULLODEN.—The month generally was fine; frost not severe enough to injure garden produce. No S. Farm work well advanced.

IRELAND.

CORK.—Generally fine, but cold, with showers. A gale in the night of the 15th, with a R of 1.87 in. Mean temp. ($46^{\circ}4$) $2^{\circ}4$ above the average of 14 years.

WATERFORD, BROOK LODGE.—S showers on the 1st and 2nd. H on the 8th. S.W. gale on the 15th.

DUBLIN.—March was a month of contrasts. As in 1889, it opened with severe weather; warm and cold spells then succeeded each other to the close of the month, heavy falls of R occurring at times. On the whole, there was a mean temp. of $2^{\circ}0$ above the average, and the R was largely in excess. Fog on the 19th, 20th, and 27th; high winds on 15 days, reaching the force of a gale on 4 days, the 7th, 8th, 10th, and 24th; S or sleet fell on the 1st, 2nd, 9th, 16th, 18th, and 23rd; H fell on 1st, 2nd, and 8th. The temp. exceeded 50° in the screen on 19 days, compared with only 2 days in February, and 17 in January, while it fell to below 32° on 4 days, compared with 5 in February, and 1 in January. On two days the thermometer did not rise to 40° in the screen. The last two days were fine, quiet, cool, and dry, the month going out "like a lamb," as it had come in "like a lion."

OMAGH, EDENFEL.—Till the end of the month, when the conditions became very favourable, there was a generally constant, though not excessive, R, and none of the trying easterly winds typical of March. The min. temp. on the 1st was the lowest of the winter.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCII.]

MAY, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

GREAT RAINFALL AT HONG KONG, MAY 29 & 30, 1889.

In the *Meteorological Magazine* for August last we printed a letter upon the above subject from Major Wilkinson, R.E., and gave also the remarkable, if not unprecedented, hourly record of the rainfall at the observatory.

We have recently received from Mr. Rogers Field, C.E., a copy of the report upon the storm by the Surveyor-General (Mr. Brown), and thinking it very desirable that it should be put upon record where it can be readily found, have reprinted those paragraphs which refer to the fall of rain, adding a few foot-notes by way of comment. We do not reprint the table of hourly fall, as it is given on p. 104 of our last volume; but we notice that it differs from our copy in the value for 1 p.m. on 29th, that was originally reported as 1·08, it now appears to be 0·08, and this reduces the total in the storm from 34·11 in. to 33·11 in.; but really in such a storm an inch more or less seems quite a trifle.

REPORT ON THE GREAT STORM AT HONG KONG, 29TH & 30TH MAY, 1889.

(Presented to the Legislative Council by command of His Excellency the Governor.)

To the HON. F. STEWART, LL.D., Colonial Secretary.

Surveyor-General's Office, Hong Kong,
July 27th, 1889.

SIR,—I have the honour to forward, for the information of His Excellency the Governor, the following report on the great rainstorm of 29th and 30th of May last, and damage caused thereby to public property.

2. The rainy season of the south-west monsoon appears to have set in earlier this year than usual. During the month of April over 12 inches of rain fell, and of this quantity nearly 7 inches was due to a storm on the 29th and 30th of that month, causing considerable damage to streets and roads which the Acting Surveyor General (Mr. Cooper) estimated at 3,400 rupees. The first half of May was comparatively dry. I arrived at Hongkong on the 18th of May.

The night after my arrival there was a very heavy thunderstorm, several buildings were struck by lightning, and 5.94 inches of rain were recorded during the day ending 10 A.M. on the 19th. On the three following days there was an aggregate fall of 5.88 inches, and there were showers at frequent intervals until the 28th. Early in the morning (2 A.M.) of 29th the rain began and continued almost uninterruptedly (although with greatly varying intensity) until 5 P.M. of the 30th.

3. On the morning of the 29th I was at the Peak, and such was the violence of the storm that (with some others who were staying at the Hotel) I had to wait a considerable time before the chair coolies would venture on the descent, owing to the force of the wind and rain. However we started about 9 A.M. I shall not readily forget the journey down. I followed the road as, all things considered, it appeared to me a preferable route to the tramway. Along the upper levels the gusts of wind threatened to carry us off the mountain path. During the descent the water rushed in sheets down the steep mountain slopes, the nullahs were full, and the side drains and culverts of the road overflowing. I arrived at the Government Offices about 10 o'clock. Shortly afterwards Mr. Bayne, Overseer (then in charge of streets, since deceased) came to report that the Glenealy culvert (which carries the storm water and sewage, and traverses the centre of the City, passing through Wyndham and Pedder's Streets, where several of the more important offices and public buildings are situated) had burst in several places. Before there was time to ascertain full details a watchman arrived to report that the service tank of the Tytam Water-works was in danger. Accompanied by Mr. Cooper I proceeded at once to the site. We arrived there a little before Noon, and found that the tunnel, or great culvert, 192 square feet in transverse area, which conveys the water of the Albany Nullah under the Tytam service tank was blocked, and the water that should pass through it was pouring over the concrete wall of the tank, and had washed away a large portion of the earthen bank on the down-stream side of the wall, as well as parts of the Bowen and Garden Roads, and had caused considerable damage to the banks of the Ravine. As the concrete walls of the tank were not designed, without the aid of the earthen bank, to resist the pressure of the water, there was good reason for taking immediate precautionary measures, so as to be prepared in the event of the failure of the tank. As the Murray Barracks are situated near the Harbour, in the bed of the same valley, 400 feet below the tank, which holds some 35,000 tons of water, I requested Mr. Cooper to give immediate notice to the officer in command of the Regiment there quartered, and I proceeded forthwith to inform His Excellency the General Commanding of the critical state of affairs. Orders were at once issued to clear the basement floors of men and stores.

4. I find on referring to the hourly record of rainfall kindly furnished, at my request, by the Director of the Observatory (Dr.

Doberck) that the rain began between 2 and 3 a.m. of the 29th and continued until about 1 p.m., up to which time $10\frac{1}{2}$ inches of rain had fallen, of which $7\frac{3}{4}$ inches fell in the three hours before Noon (10 a.m. 3.06 inches, 11 a.m. 3.35 inches, 12 (Noon) 1.27 inches). There was then an interval of two hours without rain, after which it rained moderately until near midnight. Then began the most appalling thunderstorm within my own experience, or that, I venture to believe, of the majority of the residents in the Colony. For hours flash succeeded flash in rapid succession, and the roll of the thunder was almost uninterrupted, while the rain descended in masses. Several buildings were struck by lightning, and six coolies were killed in a matched at the Peak. The damage to the structure, in the case of the buildings which I have had an opportunity of inspecting, was singularly slight. The storm raged with greatest intensity between the hours of 1 and 5 a.m. of the 30th. The rain that fell during that morning is so exceptional that I give below the result in detail.

5. After 6 a.m. the storm abated, but rain continued to fall until about 5 p.m., when it ceased. The total rain which fell during the storm from 3 a.m. of the 29th to 5 p.m. of the 30th, a period of 38 hours, was 33.11 inches, and of this quantity the very remarkable fall of 27.44 inches occurred in the 24 hours ending 6.30 a.m. of the 30th (nearly twenty-seven and a-half inches).

6. Before proceeding further it may be interesting to add that the total rainfall recorded for May was 48.84 inches, and for the six months ended 30th of June 75.45 inches. Comparing this with the records of the five years ending 1888, I find that the annual average is 84.84 inches, of which an average of 35.6 inches fell in the first half of the year, while the maximum monthly fall during these five years was 31.36 inches (in June, 1885). It therefore follows that the rainfall of the past half-year very nearly equals the average annual rainfall, and is more than double the quantity that fell in the corresponding period in former years, while the quantity that fell in May was one-third greater than that of any previous month, during these five years.

7. I have dwelt somewhat at length on this remarkable downpour because, as far as I am able to ascertain from the limited records accessible to me here, the aggregate rainfall during this storm is without precedent in the case of any storm of equal duration, and it is specially noteworthy that the fall during certain hours, and the maximum for 24 hours, appear (if I may be permitted the expression) to break the record. My authorities are two standard works on "Hydraulics," but the data are necessarily imperfect, as they do not extend to a later date than 1875. I would call attention, however, to this very interesting and important subject of enquiry, in the hope that my imperfect comparison may be supplemented (and corrected if necessary) by those who may have leisure for investigation, and access to more recent records. The practical importance of

the subject is manifest, since we must depend on the accuracy of the meteorological returns for guidance in designing works of drainage and water supply.

8. I should add that the observations were made at the Observatory at Kowloon, two miles north of the centre of the Victoria rainfall area. It is, I think, probable that the results may be safely assumed as indicating approximately the rainfall on the main island, but it would be well to bear in mind that the proximity of the steep mountain slopes to the City render it possible, judging by the records of analogous sites, that the rainfall in the City and on the mountain slopes above was greater, rather than less, than the rainfall at Kowloon.

9. For the purpose of comparison I will now quote some exceptional rainfalls recorded in other countries. At Nottingham, on 13th of August, 1857, $5\frac{1}{2}$ inches fell in about five hours. During my residence in Cyprus (December, 1880) a flood, disastrous to life and property, occurred at Limassol, where a fall of $5\frac{1}{2}$ inches was registered (nearly the whole falling in four hours). It is noteworthy that at Kowloon more than double this quantity fell in the same space of time. I can find no record *elsewhere* of a maximum hourly fall equal to that at Kowloon, viz., 3·4 inches, although it appears that the maximum on 30th May was slightly exceeded by an observation made at the Kowloon Observatory in July, 1886, when 3·48 inches was registered in one hour. Those who carefully observed the storm will, I think, agree with me, that when at its height the downpour was not constant for any considerable consecutive period, but that for short periods it was exceptionally severe, so that if the fall could have been measured for a limited period of say a quarter, or half an hour, I have little doubt that the result would have been at the rate of fully four inches per hour. In designing works in which it is necessary to provide for a maximum fall, it would in my opinion be unsafe, in the light of recent experience, to calculate on a smaller fall than four inches per hour.*

10. I would here remark that it may be argued that I am assuming that all the water that falls from the clouds is at once discharged into the water-courses, and that I am allowing nothing for absorption. To this I submit that in the case of a heavy rainfall, occurring on such steep slopes as those which form the background

* During short periods far higher rates than four inches per hour must be provided for. Even in London it will be seen from *British Rainfall*, 1878, p. 79, that for

Half a minute	the rate may be	12·0 inches an hour.
One minute	" "	10·2 "
Five minutes	" "	6·7 "
Ten minutes	" "	6·2 "
A quarter of an hour	" "	5·7 "
Half an hour	" "	4·6 "

[Ed. M.M.]

of the City, at a time when the soil has been saturated by previous heavy rains, a careful observer will, I think, be convinced that, practically speaking, all the water that falls is discharged forthwith into the sea.

11. To return to the records of rainfall in other places, the greatest fall in 24 hours I can find registered is 20·58 inches at Madras on 21st of October, 1846. The maximum at Kowloon was 27·44 inches, or about one-third greater.

12. I may conclude my observations on rainfall by adding, that although the records of Hongkong appear to be exceptional, as regards the rain which fell in a single hour, and during periods of four hours, and of 24 hours, the recorded *monthly* and *annual* rainfall of this Colony sink into insignificance compared with those of some other parts of the world. If we take the returns for Hongkong of the past six years we find that the maximum monthly rainfall is 48½ inches, and the maximum annual fall is 109 inches, while at Cherrapungi in Assam at 4,460 feet above sea level, 243 inches have been gauged in a single month (June, 1860) and during the same year 615 inches of rain fell. The monthly and annual rainfall at Cherrapungi is therefore more than five times greater than Hongkong.

13. I have been unconsciously led into considerable length on the question of rainfall, owing to the interesting nature of the enquiry, and the phenomenal character of the late storm. The subject is not without a practical application, for as the storm was exceptional in its nature, so also was the injury that resulted to public and private property; and it is noteworthy that the periods when the greatest damage occurred coincided precisely with the hours of maximum rainfall, i.e. from 10 a.m. to Noon of the 29th and from 3 to 6 a.m. of the 30th. No doubt exaggerated estimates were made at the time of the loss incurred, but this was not surprising; as the ruin wrought by the uncontrollable power of this rush of water was evident on every side, and was on a scale, and of a nature, to impress the imagination.

* * * * *

I have the honour to be, Sir,

Your obedient Servant,

S. BROWN, *Surveyor-General*.

P.S.—Since writing the above, I find that Chambers' "Encyclopædia" (ed. 1882), and the "Encyclopædia Britannica" (ed. 1884), state that at Joyeuse (France) 31·17 inches fell in 22 hours; at Geneva (Chambers says Genoa) 30 inches in 24 hours; at Gibraltar, 33 inches in 26 hours; on the hills above Bombay, 24 inches in one night; and on the Khasia Hills* (Assam) 30 inches on each of five successive days. These falls, if correctly reported, exceed that

* Another name for Cherrapungi.

registered here, but as no details are given, nor authorities quoted I hesitate to accept these statements without further evidence.*—S. B.

GREAT RAINFALL IN CEYLON, SEPTEMBER, 1872.

[As bearing on the above-mentioned excessive rainfall in Hong Kong, we have been favoured by Sir J. Coode, Pres. I.C.E., with the following brief but very useful memorandum.—ED.]

Extract from Proceedings of the Commission appointed by the Government of Ceylon to Report upon the floods that occurred there in the latter part of September, 1872.

"The rainfall during the first twelve days of last September was very great throughout the Central and Western Provinces. At Mocha estate, in Maskeliya, 34·02 inches of rain fell in 96 hours; at Yellangoury, in Dolosbágé, 23·94 inches fell in the same time."

"From the return of rainfall published by the Director of Public Works, it appears that 17·90 inches of rain fell at Avisáwélla from the 8th to 9th September; 18·80 inches at Padapolla."

ANEMOMETERS AND DAMAGE BY GALES OF WIND.

To the Editor of the Meteorological Magazine.

SIR,—Several gales, commonly so-called, have swept over this district lately, and occasioned damages to structures, and trees, &c., of more or less serious extent.

The Forth Bridge has escaped damage entirely, but some materials were blown off from a truck in a passing goods train. The Exhibition had a scaffolding erecting for a panorama blown down, and the Royal Infirmary had a portion of the outside railings exposed to the S.W. gale levelled.

What is of peculiar interest is the interpretation to be placed on the readings of the anemometers observed here, and elsewhere, in face of these results by storm to structures erected on the ground.

The plate anemometers at the Inchgarvie Station, at the Bridge on the Forth (*Scotsman*, March 12th, 1890), indicated pressures at the rate of 30 lbs. per sq. ft. (78 miles per hour), for the small gauge, and 16 lbs. per sq. ft. (56 miles per hour), for the large gauge.

The anemometers at the Paris Exhibition last season (*Times*, March 13th, 1890), indicated that at the top of the Eiffel Tower, the mean velocities were 15·5 miles per hour, and at the Observatory in the City they were only 5 miles for the corresponding period.

One would expect from these observations that portions of the highest edifices or structures would have been blown down in preference to those at the lowest levels, but here in actual practice is seen the anomaly of structures being damaged at the *lowest stages*, where the pressure of the gale per sq. ft. would be least.

Again, one would imagine that large structures would suffer from

* We are rather of Mr. Brown's opinion, but have already dealt with the subject in *Met. Mag.*, vol. xxiii. (1888), p. 99.

wind more than smaller ones would do, but there is less pressure by one half by wind recorded on the large anemometers than on the smaller ones.

An explanation of this may probably be found in the greater proportion of length of edge or border to superficial area of square feet in the object assaulted, whereby the wind gets more surface of *turning friction*, and less surface for the calm centre.

A plate anemometer with respect to the action of the wind on it, is much in the same relation as the surface of the earth is to an anti-cyclone, that is, the most wind is found on the borders of the anti-cyclone, while the middle of it is taken up by a calm centre.

Thus an anemometer plate of 30 ft. square has 120 ft. of border for the wind to turn over on, and a space of 900 sq. ft. for a *calm centre* inside this border of out-flowing wind.

But a plate anemometer of 3 feet square would have, on the contrary, only a space of 9 square ft. of area for a calm centre, and a length of 12 feet for a border for the wind to turn over.

So that the length of border in the large and small square wind gauges would be as 10 to 1, but the areas for the calm centres would be as a 100 to 1; therefore the small plate anemometer must always indicate 2-3 times more pressure than the larger one, from having proportionately more border to area.

From this it will follow that a more suitable form of plate anemometer would be the circular one, while the lengths of the borders would be more approximate to the areas inside them, in both large and small gauges, and the form would also favour the anti-cyclone-like motion of the gale of wind.

Thus, a circle of 30 feet diameter would have a border of 94 feet, and an area of 706 square feet, and a circle of 3 feet diameter would have a border of 9.4 feet and an area of 7 square feet. Each of these sets would have ratios of border to border and area to area of 10 to 1, so that both large and small anemometers of a circular shape would represent the pressure of the same gale equally anywhere at the same time.

It follows from this that there would be expected to be less wind or gale pressure on solid or filled up wall surface of any structure than on any open structure, such as scaffolding, trellis-work, ballustrading, &c.

In the former case the wind would blow over it, leaving a calm centre inside of less pressure than at the edges, and in the latter the wind would pass through it with much friction on the sides of the bars, poles, pillars, &c., composing an open edifice, and there would be no calm centre at all to compensate for this.

Open structures, like scaffolding, therefore require to be supported by *struts* to withstand any wind pressures, conjoined, as these are, with increased friction.—Yours,

W. J. BLACK, F.R.C.S.E., F.R.Met.Soc.

Cal. United Service Club, Queen Street, Edinburgh.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—In his letter on this subject in the Magazine for April, Dr. Muirhead has given us a very good description of the "filling up" of a low pressure system or cyclone, except that he seems to overlook the fact that the axis of revolution of a cyclone is inclined forwards in the direction of its motion, the lower part being retarded by friction against the surface of the earth, so that, while the general tendency of the revolving wind may be upwards, there will be a down-rush in the rear of the cyclone, a fact which accounts for the sudden fall of temperature commonly observed when the wind shifts to N. W., as the centre passes to the eastward of the observer in the northern hemisphere, the fall being generally far too great to be accounted for by the small difference in latitude between the points from which the northerly and southerly winds respectively originate in an ordinary cyclone.

But the point at issue between us is *not* how a low pressure system is "*filled up*," but how it *originates*—what it is in its initial stage. Dr. Muirhead maintains that low pressure systems are simply "areas of rarefaction," caused by local heat; my contention, on the other hand, is that this theory altogether fails to explain some of the characteristic features of the more important low pressure systems, such as those which at certain seasons of the year pass in rapid succession over our islands or their neighbourhood from the Atlantic (and it is chiefly these that the "meteorological authorities" whose nomenclature Dr. Muirhead finds fault with, refer to in their forecasts); and that a better explanation of them is to regard them as actual eddy-like depressions, originally formed in the great atmospheric currents which sweep over large areas of the globe.

Dr. Muirhead appears to consider this theory so ridiculous as to be quite unworthy of a F.R.Met.Soc., though it might be excusable in one of the "general public" who was ignorant of the simplest principles of meteorology. What does he think, then, of the following passage, penned by one who is not only a F.R.Met.Soc., but actually a secretary of that august body, and also secretary of the Meteorological Office—Mr. R. H. Scott?—"If we suppose the atmosphere to be a liquid, like the sea, and enveloping the earth, we may imagine that portion of it which lies over the Atlantic Ocean in our latitudes to be like a gigantic river. . . . On the surface of such a river we often see small waves and eddies, each with its own circulation, which are carried along with the stream. If we could look at the upper surface of the atmosphere, *supposing it to be homogeneous and of equal density throughout*, we should see somewhat similar conditions; what corresponds to the crest of the waves being patches of excessive pressure, while what corresponds to the eddies would be the areas of defective pressure. The surface, if suddenly congealed, would present the appearance of a number of

isolated mounds and pits, with very little level area at all. . . . The pits would have steep sides, be deep, and of comparatively small diameter; while the mounds, on the contrary, would be flat-topped and extensive in area. The pits are what are called barometrical depressions or cyclonic systems, from the Greek word κύκλος, because the wind whirls round them; the mounds are the areas of high pressure, called anti-cyclones, because they are the opposite of cyclones." ("Elementary Meteorology," by R. H. Scott, pp. 352-3, 1st Edition). I do not overlook the importance of the qualifying words in italics, but I think I may claim, that the view which Mr. Scott here formulates in reference to the origin of low pressure systems agrees in the main with that which I advocate.

But I can claim higher authority even than that of Mr. Scott, for this view, viz., that of the late Sir John Herschel. I do not know whether he was a fellow of the Meteorological Society: if not all I have to say is (to paraphrase a well-known saying of George Stephenson), "So much the worse for the Meteorological Society." "We have," he writes, "to consider the globe as entirely and deeply covered by an atmosphere of mixed gases—highly elastic, very dilatable by heat, and of extreme mobility: expanding itself in virtue of its elasticity out into space far above the tops of the highest mountains; yet, in virtue of its compressibility, so condensed (comparatively) in its lower strata as that one-third of its total ponderable mass lies within a mile of altitude above the sea-level, nearly one-half within two, and nearly two-thirds within five miles, within which latter limit the whole would be contained were it everywhere of the same density as on the surface; so that only about one third of its total mass is free to range unimpeded by the crests of the highest Himalaya; and not much more than two-fifths can entirely clear the range of the Andes without pressure à tergo. In consequence, when driven in the state of *wind* over these or other mountain ranges it is thrown up into vast ripples or waves, which are propagated thenceforward onwards over indefinite areas of land or sea, and become no doubt the origin of a great part of those casual fluctuations of the barometer, which give so much trouble to meteorologists." ("Popular Lectures on Scientific Subjects," by Sir John Herschel, New Edition, pp. 150, 151): That seems to me a reasonable theory of the origin of low pressure systems, and one which explains the phenomena far better, at any rate as regards the larger disturbances, than Dr. Muirhead's somewhat crude theory of areas of local rarefaction. I had intended to state for Dr. Muirhead's consideration, some well-known facts observed in connection with low pressure systems, which seem to me to stand in the way of the acceptance of his theory; but I feel that I have already occupied more than my share of space in this month's magazine. If you are willing that the discussion should be continued in your columns, you will perhaps allow me to return to the subject on a future occasion. I will only, in conclusion, express the hope that the subject may be

fully and worthily discussed, and reciprocate Dr. Muirhead's wish, "that he or I, or both of us, may be set right."

G. T. RYVES.

Team Vicarage, May 5th, 1890.

CYCLES OF DROUGHT AND GOOD SEASONS IN AFRICA.

To the Editor of the Meteorological Magazine.

SIR,—With reference to your review, last month, of my "Cycles of Drought and Good Seasons in S. Africa," I trust you will allow me a few lines to explain.

The error of one year, noted at page 125, affects the one reference only, and this not really, for an inspection of the Cyclical Diagram at page 78 will show that the rains of the 9·5 years' cycle have invariably run into a second year.

In the more recent second lecture, containing forecasts of the character of the seasons in S. Africa for the next 50 years, sun-spots, as observed, are, for forecasting purposes, discarded, and the following *three cycles only* employed: (1) 11·11 years; (2) 9·5 years; (3) 12·5 years.

In fixing dates with fractions the usual rule of taking the nearest whole figure is adopted. It is also explained in the text that with seasonal rains, as in S. Africa, the fractional half-year of a cycle becomes a whole year every two years. Thus a glance at the Cyclical Diagram for Cape Town shows that the rains of the 9·5 years' cycle—the heaviest rains at Cape Town—fall *with absolute punctuality* every nine and ten years alternately. These and all the other rains at Cape Town show a cyclical regularity, which to me, when I first studied the subject, seemed amazing. Had any one suggested such a regularity to me a few years ago, I should have viewed it with the amused incredulity that runs through your review. It is not necessary to wait ten years, as you suggest, to verify my forecasts. The odds in their favour are 49 to 1 in the case of the Cape Town meteorological records. One cannot suppose that cycles, which have rolled through their periods with unswerving regularity for 49 years, will now change, because we have mapped, and arrived at an understanding of, them! Fortunately in one sense, unfortunately in another, cyclical meteorology, as it exists in the Cape climate, is such an entirely new departure that it is difficult to get English meteorologists to examine the subject seriously.

There is every variety of climate in South Africa, from nearly rainless desert tracts to forest-clad mountains, with an average of 50 or 60 inches per year. It is certain that no writer who has not lived in the country has understood its meteorology. Most English and German writers—notably Dove recently—have fallen into the error of grouping heterogeneous stations.

It is unfortunate that "lag" rains have been misunderstood in your review. The lagging, where it occurs, is a *constant* local factor

not a promiscuous, one, two, or three years, thrown in where wanted to support a theory, as your review suggests. The nature and incidence of the lag rains of Eastern S. Africa are fully explained in the text, they being the most prominent feature in the meteorology of that portion of the continent.

I am, Sir, yours faithfully,

D. E. HUTCHINS.

Budleigh Salterton, Devonshire, 27th April, 1890.

[When an author has not merely discovered the laws of the seasons for fifty years to come, but has the odds in his favour of 49 to 1, it is natural that he should object to anything except adulation. Mr. Hutchins has not told us when his 11·11, 9·5, and 12·5 years are to start from, and, because two of his cycles have half years, seems to think that that is the only fraction with which he has to deal. Very little arithmetic is requisite to show that the matter is by no means so simple. As regards his discovery, which, if real, is probably the greatest ever made in meteorology, we adhere to our previous words, "When Mr. Hutchins can bring up evidence of 10 years' success, we will do all in our power to ensure him the honour he will merit."—ED.]

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening, April 16th, at the Institution of Civil Engineers, 25, Great George Street, Westminster, Mr. Baldwin Latham, C.E., F.G.S., President, in the chair.

The Marquis of Gallidoro and Mr. J. M. Veevers were elected Fellows of the Society.

The following papers were read :—

1. "The Cold Period at the beginning of March, 1890," by Mr. C. Harding, F.R.Met.Soc. At the commencement of the month a rather heavy fall of snow was experienced in many parts of England, and very cold weather set in over the Midland, Eastern, and Southern districts, the temperature on the 3rd and 4th falling to a lower point than at any time in the previous winter. The lowest authentic thermometer readings, in Stevenson screens, were 5° at Beddington, 6° at Kenley in Surrey and Hillington in Norfolk, 7° at Chelmsford and Beckenham, 8° at Addiscombe, 9° at Reigate and Brockham, and 10° in many parts of Kent and Surrey. At Greenwich Observatory the thermometer registered 13°, which has only once been equalled in March during the last 100 years, the same reading having occurred on March 14th, 1845. During the last half-century the temperature in March has previously fallen below 20° in only three years, whilst during the whole winter so low a temperature has occurred in only eight years out of the fifty.

2. "Note on the Whirlwind which occurred at Fulford, near York, March 8th, 1890," by Mr. J. E. Clark, B.A., B.Sc. A sharp and heavy thunderstorm occurred at York about 2.30 p.m. At the

same time, or shortly afterwards, a whirlwind passed a little to the south of the city, from Bishopsthorpe to Heslington, a distance of about four miles, its width varying from three or four to 250 yards. The author made a careful survey of the track of the whirlwind, and described the damage done by it to trees, buildings, &c.

3. "On the possibility of Forecasting the Weather by means of Monthly Averages," by Mr. A. E. Watson, B.A., F.R.Met.Soc. The author's method seems to be (1) to ascertain the average temperature, rainfall, &c. of each month; (2) to consider whether the previous months had had temperatures, &c. above or below the mean, and to assume that any such departure would be compensated in the month about to commence.

REVIEW.

Différentes formes des grêlons observés au sud-ouest de la Russie. Par Prof. A. KLOSSOVSKY. 8 vo. 14 pages, 2 plates.

OUR readers will remember that we have already drawn attention to Professor Klossovsky's work on "Thunderstorms in Russia."* In the course of 1886, he organized a series of stations for the observation of thunderstorms in the south-west of Russia; there are now no fewer than 230 such stations, and in the four years 1886-89, they sent in more than 6,000 reports—that is to say, on the average each station reported six or seven storms each year. From these reports the best of those upon remarkable falls of hail have been reproduced in this pamphlet, which is accompanied by two plates giving views and sections of the most noteworthy stones, all drawn to the natural scale. The storms dealt with are in number only eight, but of some there are two or three reports.

The largest hailstone was roughly circular 2 in. in its greatest, and about 1·8 in. in its least diameter; it was somewhat foliated in outline, but on the whole perhaps more like a round nodule of iron pyrites than anything else. It fell at the village of Zelénovka, in Kherson [about 48° 30' N. and 32° 30' E.], in the afternoon of August 19th, 1887. It had a crystalline bluish centre, and layers of more or less opaque ice around it. This was in point of size and weight far inferior to those seen and modelled by Mr. Stratten as falling at Montereau, France, August 15th, 1888, and which have been well engraved, natural size, in the *Quart. Jour. Roy. Met. Soc.* Vol. xv. p. 48.

Another stone which fell at Ratchky, in Podolia [about 49° N., and 29° E.], somewhat resembles the lady's-hand-glass pattern, frequently seen in Bavaria by Col. Ward, and engraved in the *Meteor. Mag.* Vol. xv., 1880, p. 33.

With a staff of 230 observers scattered over the vast level plains of Southern Russia, Professor Klossovsky has special facilities for the study of the formation and motion of thunderstorms, and we anticipate with pleasure further reports from him.

* *Met. Mag.*, Vol. xxi. (1886) p. 1.

SUPPLEMENTARY TABLE OF RAINFALL,
 APRIL, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	3.21	XI.	Castle Malgwyn	1.09
"	Margate, Biorhington...	2.25	"	Builth(Llanwrtyd Wells)	1.47
"	Littlehampton	2.57	"	Rhayader, Nantgwillt..	2.05
"	Hailsham	2.81	"	Carno, Tybrith	1.94
"	Ryde, Thornbrough	3.01	"	Corwen, Rhug	1.14
"	Alton, Ashdell	2.39	"	I. of Man, Douglas	1.89
III.	Oxford, Magdalen Col...	1.03	XII.	Stoneykirk, Ardwell Ho.	1.03
"	Banbury, Bloxham	1.14	"	New Galloway, Glenlee	1.97
"	Northampton	1.00	"	Melrose, Abbey Gate...	.98
"	Cambridge, Fulbourne..	.95	XIII.	N. Esk Res. [Penicuik]	1.50
"	Wisbech, Bank House..	.51	XIV.	Ballantrae, Glendrisaig	1.14
IV.	Southend	1.91	"	Glasgow, Queen's Park.	1.33
"	Harlow, Sheering	.94	XV.	Lalay, Gruinart School..	1.75
"	Rendlesham Hall	.86	XVI.	Dollar	.95
"	Diss	.91	"	Balquhider, Stronvar..	2.58
"	Swaffham	.60	"	Dunkeld, Inver Braan..	1.62
V.	Salisbury, Alderbury...	2.65	"	Dalnaspidal H.R.S.	4.23
"	Warminster	2.79	"	Arbroath Cemetery.....	..
"	Bishop's Cannings	1.76	XVII.	Keith H.R.S.	1.54
"	Ashburton, Holne Vic....	4.19	"	Forres H.R.S.	.72
"	Hatherleigh, Winsford.	2.71	XVIII.	Fearn, Lower Pitkerrie.	1.11
"	Lynnmouth, Glenthorne.	2.90	"	Loch Shiel, Glenaladale	4.81
"	Probus, Lamellyn	2.99	"	N. Uist, Loch Maddy ...	2.67
"	Launceston, S. Petherwin	3.14	"	Invergarry	3.75
"	Winanton, Stowell Rec.	3.06	"	Aviemore H.R.S.	..
"	Taunton, Lydeard Ho...	3.23	"	Loch Ness, Drumnadrochit	1.66
"	Wells, Westbury	2.62	XIX.	Lairg H.R.S.	..
VI.	Bristol, Clifton	1.14	"	Scourie	2.31
"	Ross	1.01	"	Watten H.R.S.	1.39
"	Wem, Clive Vicarage ...	1.14	XX.	Dunmanway, Coolkelure	3.83
"	Cheadle, The Heath Ho.	1.36	"	Fermoy, Gas Works ...	1.43
"	Worcester, Diglis Lock	1.09	"	Tipperary, Henry Street	1.55
"	Coventry, Conndon	1.49	"	Limerick, Kilcornan ...	1.09
VII.	Ketton Hall [Stamford]	.82	"	Miltown Malbay	1.40
"	Grantham, Stainby	.60	XXI.	Gorey, Courtown House	1.57
"	Horncastle, Bucknall ...	.18	"	Navan, Balrath	.99
"	Mansfield	..	"	Mullingar, Belvedere...	1.27
VIII.	Neston, Hinderton	1.09	"	Athlone, Twyford	1.46
"	Knutsford, Heatside ...	1.02	"	Longford, Currygrane...	1.34
"	Lancaster, South Road.	1.63	XXII.	Galway, Queen's Coll...	1.67
"	Broughton-in-Furness ..	2.54	"	Clifden, Kylemore	2.58
IX.	Wakefield Prison	.65	"	Crossmolina, Enniscoe..	2.31
"	Ripon, Mickley	1.01	"	Collooney, Markree Obs.	1.86
"	Scarborough, West Bank	.92	"	Ballinamore, Lawderdale	..
"	East Layton [Darlington]	.81	XXIII.	Warrenpoint	1.67
"	Middleton, Mickleton..	1.31	"	Seaford	1.24
X.	Haltwhistle, Unthank..	1.35	"	Belfast, New Barnsley..	1.84
"	Shap, Copy Hill	1.65	"	Bushmills, Dundarave...	1.18
XI.	Llanfrechfa Grange	1.27	"	Stewartstown	1.78
"	Llandoverly	2.07	"	Bancrana	1.82

APRIL, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which 40 or more fell.	TEMPERATURE				No. of Nights below 32°
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		In shade. On grass.	Max.		Min.				
				Dpth.	Date.		Deg.		Date	Deg.	Date		
I.	London (Camden Square) ...	2·02	+ ·28	·54	25	16	64·3	30	30·5	5	3 12		
II.	Maidstone (Hunton Court)...	2·73	+ 1·08	1·23	25	11	...	...	...	...	...		
III.	Strathfield Turgiss	1·70	+ ·10	·33	23	17	66·3	30	25·3	5	6 17		
III.	Hitchin	·62	- 1·17	·23	15	15	62·0	30	28·0	1	6 ...		
IV.	Winslow (Addington)	1·21	- ·71	·22	26	15	64·0	30	23·0	2, 5	7 15		
IV.	Bury St. Edmunds (Westley) ...	·84	- ·82	·20	21	11	...	...	...	...	...		
V.	Norwich (Cossey)	·91	- ·80	·20	8	15	...	...	...	...	...		
V.	Weymouth (Langton Herring) ...	3·00	+ 1·12	·73	24	18	60·0	15	31·0	4, 12	3 ...		
"	Barnstaple	2·54	+ ·36	·81	28	13	61·0	16	31·0	4	...		
VI.	Bodmin (Fore Street)	3·18	+ ·11	·94	24	18	...	...	...	...	...		
VI.	Stroud (Upfield)	·97	- 1·18	·15	23	16	64·0	30	31·0	1, 6	...		
"	Churchstretton (Woolstaston) ...	1·02	- 1·32	·23	25	12	63·0	30	29·0	4	7 14		
VII.	Tenbury (Orleton)	1·52	- ·56	·42	15	14	65·0	30	24·2	2, 4	10 13		
VII.	Leicester (Barkby)	·82	- 1·28	·16	15	14	71·0	30	20·0	1	11 20		
"	Boston	·50	- 1·21	·16	6	10	70·0	29	24·0	2, 4	7 ...		
"	Hesley Hall [Tickhill]	·33	- 1·38	·11	7	10	68·0	30	24·0	1	10 ...		
VIII.	Manchester (Plymouth Grove) ...	·74	- ·97	·27	6	12	68·0	30	29·0	11	4 9		
IX.	Wetherby (Ribston Hall) ...	·65	- 1·20	·23	13	9	...	...	...	...	...		
"	Skipton (Arncliffe)	2·38	- 1·05	·78	6	14	63·0	30	28·0	10	6 ...		
"	Hull (People's Park)	·82	- 1·10	·25	12	14	...	...	...	...	...		
X.	North Shields	·50	- 1·17	·15	7	10	63·0	30	28·0	11	9 14		
XI.	Borrowdale (Seathwaite)	4·55	- 2·59	1·50	6	13	...	...	...	...	...		
XI.	Cardiff (Ely)	2·12	- 29	·38	28	17	...	...	...	...	...		
"	Haverfordwest	1·79	- ·84	·40	6	12	59·0	14a	25·0	11	7 9		
"	Plinlimmon (Cwmsymlog)	2·19	...	·84	6	9	...	...	...	...	...		
XII.	Llandudno	1·09	- ·72	·23	10	11	64·8	30	32·0	12	1 ...		
XII.	Cargen [Dumfries]	1·44	- ·79	·47	21	12	62·8	30	25·6	12	10 ...		
XIV.	Jedburgh (Sunnyside)	·77	- ·93	·18	24	13	64·0	30	24·0	13	12 ...		
XV.	Old Cumnock	1·91	- ·22	·40	22	13	64·0	30	20·0	10	15 ...		
XV.	Lochgilphhead (Kilmory)	3·15	+ ·34	·55	20	13	...	...	...	...	...		
"	Oban (Craigvarren)	2·09	...	·50	6	12	58·6	30	31·1	13	2 ...		
"	Mull (Quinish)	2·25	- ·73	·36	21	13	...	...	...	...	...		
XVI.	Loch Leven Sluices	·70	- 1·52	·30	22	...	...	...	...	...	...		
XVII.	Dundee (Eastern Necropolis) ...	·65	- 1·40	·15	21	8	64·0	2	28·4	13	5 ...		
XVII.	Braemar	1·81	- ·61	·36	21	17	59·8	3	21·8	14	11 23		
XVIII.	Aberdeen (Cranford)	1·46	...	·27	28	23	62·0	3	26·0	12	5 ...		
XVIII.	Strome Ferry	2·47	- ·45	·86	6	13	...	...	...	...	...		
XIX.	Culloden	·49	- ·55	·20	23	...	61·0	2	25·0	13	6 22		
XIX.	Dunrobin	...	...	...	...	...	...	...	...	...	...		
"	S. Ronaldsay (Roeberry)	...	...	...	...	...	...	...	...	...	...		
XX.	Cork (Blackrock)	1·33	- 1·56	·21	23	14	69·0	27	30·0	2	1 ...		
"	Dromore Castle	2·31	- 1·30	·52	6	12	66·0	5	31·0	2	...		
"	Waterford (Brook Lodge) ...	1·30	- 1·17	·28	23	15	61·0	21	28·5	4	3 ...		
XXI.	O'Briensbridge (Ross)	1·10	...	·43	6	13	61·0	30	31·0	3	4 ...		
XXI.	Carlow (Browne's Hill)	...	...	...	...	...	...	...	...	...	...		
XXII.	Dublin (Fitz William Square) ...	1·58	- ·54	·44	15	14	63·6	20	31·2	3	1 12		
XXII.	Ballinasloe	1·16	- 1·18	·19	6	16	59·0	20	26·0	3	9 ...		
XXIII.	Waringstown	1·43	- ·99	·19	24	18	65·0	28	25·0	2	7 12		
"	Londonderry (Creggan Res.) ..	1·67	- ·57	·27	9	15	...	...	...	...	...		
"	Omagh (Edenfel)	1·72	- ·51	·33	25	16	64·0	28	30·0	2	4 8		

a And 15, 28, 29. b And 3, 4, 10, 11. c And 5, 12.

+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON APRIL, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—The weather of this month in particular, and of the spring in general, has been so pre-eminently favourable for farming operations, that the British farmer will have to look about for something else to grumble at, the only grievance in this district being that the bloom of the fruit trees has suffered from night frosts.

ADDINGTON.—Very sharp frost on 2nd and 5th, and the nights cold throughout the month. Bar. very low on 15th, 16th and 17th; on 17th a dense fog lasted all day. Swallow arrived on 15th, cuckoo heard on 16th, and nightingale on 27th. R from January 1st to April 30th 5·70 in., the least registered in the first four months of the year during 20 years.

BURY ST. EDMUNDS, WESTLEY.—A dry month, with many slight frosts. The hay crop is likely to be short in Suffolk.

LANGTON HERRING.—R 79 in. above the average of 15 years. Mean temp. at 9 a.m. 1°·5 below the average. Solar halos were frequent. Dense fogs on 6th, 21st, and 22nd.

BODMIN, FORD STREET.—A very cold month; very high winds on several days from the N. and N.W. L on the 15th; S, sleet and H on the 10th. A splendid warm summer's day on the 30th.

STROUD, UPFIELD.—About an inch of S fell on the 10th about 6 a.m., and melted by 10 a.m. T heard in the E. and W. on the 16th.

WOOLSTASTON.—A rather cold month, especially the first fortnight, during which there were constant frosts. S fell on 10th. Mean temp. 44°·4.

LEICESTER, BARKBY.—Hailstorm and L on the 7th. First swallow seen on the 16th, cuckoo on the 24th.

BAWTRY, HESLEY HALL.—A cold, dry month.

MANCHESTER, PLYMOUTH GROVE.—The R was the smallest in April for 23 years, excepting 1873. Mean temp. 46°·8. Thick fog on the morning of the 5th; bitterly cold E. winds from 14th to 19th; the last ten days fine, and mostly bright and sunny.

HULL.—The weather during the month was generally dry, often with cold E. or N.E. winds; overcast or very cloudy from the 12th to the 24th, much less so during the early and latter parts of the month.

WALES.

HAVERFORDWEST.—A very dry, fine April. The wind blew with considerable force from N. and E. on 15 days, from the W. and S.W. on only 7 days, the remainder from N.W., consequently the temperature was below the mean, and the sky mostly cloudless, with sharp night frosts; a wholesome check was thus put to vegetation, which was unusually forward, owing to the mildness of March. Blackthorn in blossom on the 4th, horse chestnut in leaf on the 15th; cuckoo heard on the 24th.

SCOTLAND.

CARGEN.—The mean temp. of the month (44°·4) was 1°·5 below the average. Easterly winds prevailed for 18 days. Sunshine (165 hours) exactly the average. The low temp. of the month somewhat checked vegetation, which, however, was considerably in advance of what it usually is at this season. The

E of the first quarter of the year (11·32 in.) is 2·87 in. below the average of 30 years. T, L, and heavy H on 26th; T and S showers on 7th.

JEDBURGH.—N., N.E., and S.E. winds prevailed, often with frost, but there was a good deal of sunshine. Vegetation progressed little. Temp. low.

OBAN, CRAIGVARREN.—A fine seasonable month, with moderate E, and warm weather.

CULLODEN.—Little E fell during the month, and the temp. was very low, frost occurring nearly every night; vegetation much retarded.

IRELAND.

CORK.—On the whole a genial month, only one shade frost. E less than half the average of 25 years. Mean temp. 50°·6, 2°·7 below the average of 14 years.

WATERFORD, BROOK LODGE.—A good deal of E. wind during the month; mean temp. 47°·3.

ROSS, O'BRIENSBRIDGE.—E small; harsh cold winds from N.E., S.E., and N.W. prevailed, checking vegetation. A rise of temp. occurred on 27th, and the last three days were genial and pleasant. Frosts very slight.

DUBLIN.—April was generally a favourable month. The mean temp., E and rainy days were all somewhat below the average. Considered by weeks, the weather was first fine, dry and quiet; then cold and showery; then dull and cheerless; then unsettled, squally and showery, and lastly fine. Mean temp. 47°·3. Lunar halo on 24th; foggy on eight days; high winds on 11 days, on two occasions attaining the force of a gale. S or sleet on 10th, H on five days. Temp. in screen exceeded 50° on 23 days. T in W. at 0.10 p.m. on 26th.

OMAGH, EDENFEL.—The month commenced with brilliant weather, and as a seed time was excellent throughout, but the prevalence of dry easterly winds, and frequent night frosts, occasioned vegetation to be but little further advanced at the close than at the commencement.

WEATHER FORECASTING.

To the Editor of the Meteorological Magazine.

SIR,—In a report of the April meeting of the Royal Meteorological Society, published in "Nature" [April 24th, 1890, page 598], the following sentence appears:—"On the possibility of forecasting the weather by means of monthly averages, by Mr. A. E. Watson. The author is of opinion that the average values of meteorological phenomena are constant quantities, and that any variation from them is sure to be met by a compensating variation in the opposite direction."

This no doubt states a very interesting and important fact which I may be bold enough to add is quite independent of the opinion of Mr. A. E. Watson—but surely my brother Fellows of the Roy. Met. Soc., knew it before, or they could have found it in any dictionary. If "any variation from" an average is not "met by a corresponding variation in the opposite direction," so much the worse for that average.

Mr. Watson will, I hope, forgive the above remark, for I cannot believe that the report describes the subject of his paper, but I think that few readers would repress a smile at the Roy. Met. Soc., on seeing such an account of its proceedings in the pages of our leading scientific journal.

I am, sir, yours obediently,
A F.R. Met. Soc.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCIII.]

JUNE, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE GREAT DEVONSHIRE RAINS OF MAY 25TH.

We have so constantly tried to induce rainfall observers to believe that six inches of rain may fall on one day, and so rarely succeeded, that it is a great satisfaction to have a case in which, though more might have been done, the totals are accurately known—the inner vessels ran over, but the outer ones saved the overflow—and the two gauges in Tiverton collected respectively 4·85 in. and 5·20 in., of which as nearly as we can tell about four inches came down in two hours. We will in the first place give the reports which these two correspondents have kindly sent us, and also the notes from all the stations where the fall exceeded two inches.

To the Editor of the Meteorological Magazine.

SIR,—I have tested the rain gauge, and find that the outer can would hold nearly 7 inches of water without running over. We measured the contents very carefully at 9 a.m. on Monday (26th), as usual, and recorded 5·20 in. The rain commenced here at 2.15 p.m. on Sunday (25th), and was soon followed by a hail storm of unusual severity, lasting for two hours, and causing great damage, cutting through our verandah, which is canvas painted, and riddling it as if shot through by bullets. It otherwise did immense damage to garden frames, &c. The heavy rain, accompanied by terrible lightning, lasted until 4.30 p.m., when the latter subsided, but the rain continued, off and on, up till 10 o'clock, but not with any violence after 4.30 p.m. The devastation caused in and around Tiverton is extraordinary.

Yours very truly,

M. DICKINSON.

Broomhill, Tiverton, May 31st.

P.S.—The bottle in our rain gauge overflowed into the tin, but, it being watertight, the overflow was quite safe, and carefully measured.

SIR,—The storm on Whitsunday begun at 2.15 p.m., with lightning, followed almost immediately by loud thunder, heavy rain, and soon by large hail. The worst of the storm lasted about 2 hours, but rain

continued to fall heavily, with occasional thunder, not so near, for an hour more, and distant thunder and showers of rain occurred at intervals all the evening.

The storm began very suddenly; at 1.55 it was hot and bright, as in the morning, 82° in the shade, and no one had umbrellas. At 2.15 a few large drops were falling, and before 2.20 the thunder had begun.

The gauge was visited at 5.15 p.m., when it was still raining slightly, a jug being taken to bring in the rain for measurement. It was then found that the bottle (which we have since twice measured and found to hold 3.27 inches) had run over, and the overflow was preserved in the outer case. The bottle was emptied into the jug, but so nearly filled it that the overflow water was not then touched, and the emptied bottle was replaced. In the morning the bottle was found to contain 0.35 in., and the case 1.23 in. The fall, therefore, was, between—

2.15 and 5.15	...	...	...	...	4.50
5.15 and 9 a.m. (26th)	...	...	...	...	.35
Total to be entered to 25th					4.85

The damage is now estimated at £750 to roads, and £1,000 to private property.

The streets were re-laid in the winter, and rolled in with a steam roller, and they have only been washed bare; but as soon as you pass into a road you see the wreck of the storm. The chief damage is (to roads) E. and W. On the N. and S. the river Exe received the water from the hills, and carried it off without flooding, but the Lownam river and a small stream that flows into it, the Ailsa brook, overflowed and did much damage.

West of the town, in two directions, three steep roads meet just before the streets begin, and in both cases the main road is more like the moraine of a glacier in miniature than a civilized road. The granite blocks edging the footpath are washed up and tossed on the heaps of gravel and stones where the road was, and in one case a broken culvert completes the scene of ruin.

Owing to illness in the house I have not seen the roads on the E., but hear that they are quite as bad, with trees torn up, and a hedge washed into the middle of Tidcome-lane, which is also blocked by a broken culvert.

The damage to houses was chiefly caused by the water pipes and shoots overflowing, being choked by the large hail; the streams pouring from these caused the floods in the streets, where the gratings were also stopped.

The flood in St. Peter-street (ours) went down by 5.0 p.m., but the water in Westexe was still high at 8.30. That part of the town below the bridge is much lower than ours.

Yours truly,

H. S. GILL.

Tiverton, June 2nd, 1890.

SIR,—Morning of 25th very close and sultry, about 2 p.m. distant T in the E., which became heavy and continuous by 3 p.m. About 3.30 a few enormously large drops or splashes of water fell at intervals, and shortly after a heavy downpour set in, 0.18 in. falling in 15 minutes. About this time a remarkably brilliant flash of L was accompanied by a nearly simultaneous deafening report. L became incessant and T heavy and continuous, but the R was not remarkable, and the storm subsided considerably by 4.45 p.m.

At 6 p.m. another very black storm came over from the E., and at 6.45 a very heavy downpour set in, and in about an hour, 1.56 in. of R was registered. By 8.30, the R had nearly ceased, and a black cloud in the W.N.W. (from which L was frequent) marked the retreating storm.

The total rainfall for the five hours during which these storms lasted was 2.07 in., as recorded by the registering pluviometer, 10 ft. above the ground.

The records of the various gauges are as follows :—

1890, May 25th.—A.	2.13 inches =	old 5 in. gauge, 1 ft. above ground.
C.	2.21 " =	5 " 4 " "
D.	2.12 " =	new 5 " "
E.	2.07 " =	8 in. Richard recording gauge.

No rain was registered May 24th and 26th.

The barometer gave no indications of the approach of these storms, the barograph trace showing a very gentle decline. Between 2 and 7 p.m. the trace is considerably shaky, as if from the jar of the thunder, and a decided disturbance is shown about 5.15 p.m.

C. GROVER,
(Asst. to C. E. Peek, M.A.)

Rousdon Observatory, Lyme.

SIR,—Thunderstorms are not of frequent occurrence here, but we had one yesterday of exceptional duration and rainfall. T was first heard about 2 p.m. The first drops of R fell at 3 p.m., and R ceased shortly after 8 p.m. At 9 p.m. I measured the fall and found it to be 2.77 in.

The fall was not quite continuous and varied much in intensity, but the gauge being far from the house I could not take the measurements at successive periods as I should have liked to do. The hour from 6 to 7 would, I believe, have shewn a most unusual rate of fall.

The heaviest falls I have previously registered were :—July 14, 1875, 2.72 in., a steady downfall for about 20 hours, without T, and December 26, 1886, 2.53 in., a violent gale, finishing with S of unusual density.

Extensive damage is reported from Lyme and Uplyme this morning.

Yours very truly,

E. L. AMES.

Cleavelands, Lyme, Dorset, May 26, 1890.

SIR,—We had 2·14 in. of R on the 25th. It rained heavily from 3 to 4 p.m., but the tremendous storm was from 6·30 to 7·30 p.m., when the H and T were awful.

Great Trill, Axminster.

F. J. SPARKS.

From Tiverton to Exeter is about 12 miles, and before we proceed to a general summary of the storm we think that the following note on the state of the Exe, at a little N. of Exeter will be illustrative. We have already seen that at Tiverton the rain began at 2.15 p.m., and that by 5.15 the exceptional features had passed, and the water was clearing out of the streets. Evidently, therefore, the rush into the Exe at Tiverton may be said to have been from about 4 to 6 p.m. Allow the flood to pass from Tiverton to Exeter at 5 miles an hour, then the maximum flood at Brampford Speke should be from about 6 to 8 p.m. Now for the report of Miss Gamlen's gardener. "The river was a little puddled at about 6 p.m., but in a quarter of an hour it came down like mud for two hours; I never saw anything like it. Three pigs, hedgehogs, cats, rats, a tub of barley meal, corked bottles, boxes, tins, all sorts of things floated down. At 8 p.m. it was at its height."

As regards rainfall, it was far heavier in Tiverton than anywhere else of which we have yet heard. It was, as all such storms are, very local; for instance, even at Cove, which is in Tiverton parish, but about four miles N. of the Town, the fall was only .90 in.

We may perhaps as well dispose of the rainfall at once. There was a slight TS, with from $\frac{1}{4}$ to $\frac{1}{2}$ in. of R in the S.W. of Ireland. At Swansea in S. Wales there was a local heavy R, 1·53 in. falling in 1 hr. 33 min. There were TSS with slight R over much of Cornwall and Devonshire, but though we have been favoured with many returns, the only places at which we have yet heard of an inch falling on the 25th are—

Lyme Regis (Rousdon Obs.)	2·21 in.	Lyme Regis (Holm Cleve)	...3·70 in.
" " (Clevelanda)...	2·77 "	Cullompton.....	1·08 "
Axminster (Great Trill) ...	2·14 "	Tiverton (St. Peter's Street)	4·85 "
" "	1·20 "	" (Broomfield)	5·20 "
" (Furzebrook)...	1·03 "		

Reference to a map will show that these returns are (with only one exception, Cullompton, which was only just over an inch and which is about midway between) from two small areas, one of about four miles square to the W. and N. of Lyme Regis, the other about one mile square over Tiverton. As regards Lyme Regis, it is impossible to speak positively, as two observers there allowed their gauges to run over.

As regards the time and progress of the storms the facts are as confusing as is usual. The following very interesting table, prepared by Mr. Greenwood Penny, of High Bickington, Torrington, was published in the *Devon and Exeter Gazette*, and we reprint it as a useful lesson upon the subject.

Locality.	Commencement of Storm.	Killed by Lightning.			
		Man.	Horses.	Sheep.	Bullocks.
Axminster	Afternoon				
Barnstaple	2.30 p.m.				
Black Torrington	2.30 p.m.	.....	.....	6	
Bradworthy	Afternoon	.....	.....	21	2
Bramford Speke	1 p.m.				
Bude	2 p.m.				
Crediton	3 p.m.				
Dawlish	Afternoon				
Dunkeswell	1 a.m. and again evening				
Exeter	0.30 p.m.				
East Budleigh	3 p.m.				
High Bickington	2.15 p.m.				
Holsworthy .....	.....			4	
Halsdon	3 p.m.	.....	..	4	
Huish	1 p.m.	.. ..	1		
Little Torrington .....	.....	1	.. ..	4	
Moretonhampstead	3 p.m.				
Petersmarland	1 a.m.				
Powderham	3 p.m.				
Sandford	1.30 p.m.				
Stratton	2 p.m.				
Tiverton	2 p.m.				
Topsham	2.30 p.m.				
Witheridge					

OTHER CASUALTIES.—Holy Trinity Church tower, Barnstaple struck 6.30 p.m. Holsworthy church tower struck 3 p.m. Mr. Payne's house at Merton struck. Outbuildings struck and burned, property of Mr. Oatway, Tawstock, near Barnstaple. House struck at Topsham (Mr. F. Underhill's). Angel Hotel and outhouses struck at Witheridge. Trees struck in many localities.

Summing up, Mr. Penny said that "the above table, compiled chiefly from reports which appeared in your columns, may be of interest in showing at a glance, the area covered by the thunderstorms of Whit-Sunday, the time of their occurrence in various localities, and the disasters occasioned by lightning alone. It will be seen that the storm of Sunday afternoon was preceded by another in the early hours of the morning, over Exeter, Exmouth, and Powderham, where the hail is reported to have done considerable damage. Another storm developed over Holsworthy at about 5 a.m., but Sunday forenoon appears to have been universally bright and fine, the temperature being unusually high for the time of the year. The second, and by far the more destructive storm, developed over the greater part of Devonshire between the hours of 1 and 4 p.m., reports of its severity having reached from Barnstable (North), Dawlish (South), Axminster (East), and from Bude and Stratton, Cornwall (West). In Mid-Devon, especially in the neighbourhood of Tiverton and Holsworthy, the severity of the storm is reported to have been almost unprecedented. The generally received opinion that summer thunderstorms arise from the rapid condensation of vapour, and consequent development of electricity, from a warm humid atmosphere by the chilling influence of cold air currents and changes of wind in its higher regions, seems to be borne out by the facts. So

extremely rapid was its formation that it came upon us in apparently calm, settled, bright summer weather, with scarcely an hour's warning. We have no records of its commencement anywhere before mid-day, and at 3 p.m. it was raging furiously over nearly the whole county. Here at High Bickington the sky was cloudless at mid-day. At 3 p.m. distant thunder was heard, the sky being then overcast to the S.E. At this hour I noticed the rapid formation of cumuli clouds in the clear sky, which soon coalesced in large rolling masses, darkening the whole heavens. In another half-hour the storm was raging in all its fury, and continued with intermissions until late in the evening. The barometer which had been steady at about 29.5 during the previous twenty-four hours, rose slightly when the storm was at its height."

But the above leaves much uncertain: take, for instance, the Lyme Regis storms. Mr. Cuthbert Peek's observer speaks of them distinctly as coming from E. and passing to W.N.W., but while the first of these was E. of Lyme Regis, torrents of rain were flooding Tiverton, which is N.W. of Lyme. Evidently, therefore, the Tiverton storm was either formed locally or came from the opposite direction. Our impression is that we shall arrive at a true knowledge of the path of storms, only by one or other, or both of two methods (1) by enormously increasing the number of observers—say to one in every alternate village, or (2) by fixing the paths of the storms by trigonometrical observations from lofty observatories like Mr. Prince's.

We need not add details as to flooded cellars, washed away gardens and fowls, nor where the pigs seen floating past Exeter had come from—all who know anything of rainfall know that with four inches of rain in three hours mischief always occurs.

OZONE AND WIND.

To the Editor of the Meteorological Magazine.

SIR,—The determination of ozone in the atmosphere, as at present conducted, is still, I suppose, somewhat lacking in exactness and certainty. Assuming, however, that the daily observations of this substance at Greenwich, published in the *Weekly Return* of the Registrar-General, are an approximation to the truth, the following analysis which I have made of the data for last year (1889) may be not without interest, even if it contain nothing very novel.

The presence of ozone was recorded, I find, on less than half the days, there being 193 days with no ozone. The quantities are represented by figures, ranging to about 17. The days with ozone were:—

0 to 1	=	46	Brot. up	142
1 to 2	=	24	6 to 7	= 7
2 to 3	=	31	7 to 8	= 4
3 to 4	=	17	8 to 9	= 6
4 to 5	=	12	9 to 10	= 3
5 to 6	=	12	10 and above	10
Carried up	142		Total	172

Thus the maximum is in the lowest category, then follow the third, the second, &c.

Now, taking out the ten highest records, and comparing with the direction of the wind, we get the following list:—

Date.	Ozone.	Wind direction.							Hor. movement, dep. from average. (miles.)
		W.S.W.	S.W.	S.S.W.	S.	S.S.E.	S.E.	E.S.E.	
1. March 8.....	17·5	...	...	x	...	x	...	...	+123
2. July 10.....	15·8	...	x	x	x	..	x	...	+ 76
3. May 31.....	12·8	...	...	x	x	...	...	...	+ 75
4. May 30.....	12·0	...	...	x	x	...	...	...	+116
5. April 4.....	11·2	...	...	x	...	...	...	...	+ 3
6. Oct. 19.....	11·2	...	x	x	x	...	x	x	+ 74
7. March 7.....	10·5	...	...	x	...	x	x	...	+149
8. April 20.....	10·5	x	x	x	...	...	..	...	+111
9. April 22.....	10·5	x	x	x	...	...	...	...	..
10. July 25.....	10·5	x	x	..	...	...	...	...	+206

Three things may here be noted:—

(1). The highest records are, with one exception, in the period March to July (the exception being in October). There was most ozone in the spring and early summer.

(2). The wind-directions on those days are all included in the arc W.S.W. (by S.) to E.S.E. We find in the above list that W.S.W. occurs 3 times, S.W. 5, S.S.W. 9, S. 4, S.S.E. 2, S.E. 3, and E.S.E. 1. Thus the maximum appears to have been with S.S.W.

(3). The horizontal movement of the air was in each case in excess (in one case there is no record). Doubtless the amount of movement affects the record considerably.

We may now look at the cases of no ozone. On most of those 193 days some wind-direction in the northern half of the circle is recorded (W. by N. to E.), though there may be other directions. There are, however, a certain number of cases of no ozone (34), in which the wind-directions were exclusively within the arc indicated above—viz., W.S.W. (by S.) to E.S.E.

Now we find, on examination, that in the great majority of those cases there was a *deficiency* (generally considerable) of wind. Eliminating these, we have a residuum of the following cases of no ozone, with wind in the ozone-yielding arc (as we may call it), and in excess of the average velocity:—

January 18	...	S.W.	S.S.W.	.....	+ 6
February 16	W.S.W.	S.W.	S.S.W.	.....	+58
August 28	..	S.W.	S.S.W.	.....	+74
December 10	W.S.W.	S.W.	...	.....	+88

Thus it seems that we may have a considerable amount of south-westerly wind and no ozone. It may be noted, however, that none

of these four days were in the spring and early summer, in which we find the highest proportion of ozone.

We may, again, look at the matter thus: Here is a table which shows (1) the monthly relative proportion of south wind at Greenwich last year (including reductions); (2) the daily average of the amount of ozone in each month; (3) the number of days in each month on which ozone was observed:—

	S. wind (days.)	Ozone (daily average.)	Ozone (days observed.)
January.....	10	0·4	8
February.....	4	0·3	8
March.....	8	2·5	17
April.....	13	3·6	20
May.....	10	3·5	24
June.....	8	0·7	7
July.....	9	2·6	21
August.....	11	2·1	23
September.....	6	0·7	9
October.....	12	2·4	15
November.....	8	0·3	7
December.....	12	1·0	13

Any one who will take the trouble to make out curves of these figures will find a fair general correspondence. A. B. M.

WIND CHANGES—PRE-INSTRUMENTAL METEOROLOGY.

To the Editor of the Meteorological Magazine,

SIR,—In your review of Mr. Prince's "Summary of a Meteorological Journal," you suggest, as a possible cause of the change from S.W. to N.E. in the direction of our Sussex winds, that additional building may have affected the indications of his vane. But this will not explain the phenomenon, which is a real and objective one. My own register shows precisely the same thing, and my vane, as you know, is at the top of a pretty tall mast in the middle of an acre of paddock, where it has remained unchanged, in locality and surroundings, for more years than I care to count. It is really very curious to go through back records and see how absolute the change has been. I cannot fancy that so notably-marked a phenomenon can be confined to Sussex. It must have some terrestrial—or even cosmical—cause, and, if this be so, should be evident in other localities.

The other matter on which I wished to write was suggested to me by a passage in your article on "Pre-instrumental Meteorology," which set me hunting up some records of storms and floods in our "Sussex Archæological Collections."

I have copied two or three of the most notable accounts from the "S.A.C." volumes, and enclose them.

Very sincerely yours,

WILLIAM NOBLE

Forest Lodge Maresfield, Uckfield, May 14th, 1890.

THE GREAT STORM OF DECEMBER 8TH, 1703.

"The great storm of November 27th (Dec. 8th N.S.) 1703, in which Bishop Kidder (a Maresfield man) and his wife were killed in bed, at Wells, by the falling of a chimney stack, and Winstanley's Eddystone Lighthouse disappeared, was much felt in Sussex. Houses were untiled at Midhurst, four or five stacks of chimneys blown down at Cowdray, Osborn church steeple blown down. 'The Shoreham Market-house, an ancient and very strong building, was blown flat to the ground, and all the town shattered.' It tore the lead off Brighthelmstone Church, and overthrew two windmills. The hedges were salt twenty miles from the sea, and the grass on the Downs about Lewes so salt that the sheep would not eat it; while "the miller of Berwick, three miles from the sea, while attempting with his man to secure his mill, was so washed with flashes of sea water, which he represented as beating against them like the breaking of waves against the rocks, that they were almost strangled therewith, and forced to give over their attempt, and in consequence the mill was considerably damaged."

HEAVY THUNDERSTORM, MAY 22ND, 1728.

"May 11th (22nd N.S.) 1728, at Hurstpierpoint. A dry day until towards night, then rain, thunder, and lightning, and a very great storm and tempest. May 13th (24th N.S.). The storm on Saturday proved to be very great, especially the hail, which was prodigious. Many of the stones were as big and some bigger than hens' eggs. The windows of some houses about here were almost all broken. The corn was much injured."—*Diary of Thomas Marchant*, "*Sussex Archaeological Collections*," Vol. XXV., p. 19.

HEAVY THUNDERSTORM, MAY 16TH, 1797.

"May 16th, 1797. On Sunday, the 7th of this month, I was engaged to officiate, at 3 o'clock in the afternoon, at St. Michael's in Lewes, for Mr. West. I had entered my carriage at half-past 1 to go there, not conceiving it possible I could be prevented, but a storm of thunder and lightning and hail came on with great violence, as we were coming from Chailey Church, after morning service. I thought it too violent to continue any time, and had no doubt of going to Lewes, but it kept increasing, and the rain came in such torrents, that before half an hour the flood was immense. The sheep stood belly deep in the Green before the house, and the orchard and lawn and the lower island pond were one sheet of water; and the rain so continued until past 3 o'clock, when the deluge was beyond description, and the water on the lawn was twelve feet deep, as I myself measured it, from where it had stood, at against the old road that intersects it. Had I have attempted to have gone to Lewes the flood at Bevan's Bridge would have rushed in at the chariot windows; indeed, it would have been useless to have attempted to pass, for at 7 in the evening a man and horse were

swimming there. But the very extraordinary part is that there was no rain at Lewes ; and there the congregation was all assembled, and waiting for me with great impatience. The hail was large, and broke some panes of glass, but did no other material mischief ; in truth, it was such a flood as was never known before, and as never covered anything like the ground, or fell in so short a time, at most three hours. I never saw anything like it, except some years ago in London, when the people waded knee deep in Piccadilly, and when so much of Tower Hill was torn up that they talked of an earthquake, and there was neither then nor now any wind."—*From an old Account Book kept by the Rev. Sir Henry Poole, Bart., of the Hooke, Chailey, Sussex.*—*Sussex Archaeological Collections, Vol. XII., p. 3.*

During the same flood the stone parapet of Uckfield old bridge was carried away, and some persons standing on the bridge were drowned.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—Replying to Mr. Ryves, I beg to say that I do not see that the inclination of the axis of a cyclone has much to do with the question at issue, which, he says, "is not how a system of low pressure is 'filled up' but how it *originates*."

Twenty months ago, when I asked of the Hon. Ralph Abercromby, as a super-eminent meteorological authority, what originates the diminished aerial pressure in cyclonic disturbances, he shook his head and owned he did not know. And I am afraid that neither Mr. Ryves nor myself are yet able to help him with a theory, "crude" or other.

Mr. Ryves should not say that I assert cyclones "are caused by local heat," though I have said that heated ground warms contiguous air. Heating, likely enough, may be a cause, or concomitant, of cyclonic disturbances, but I have not said so in either of my letters.

If Mr. R. H. Scott's "Pits [that] are what are called barometrical depressions or cyclonic systems" gyrate earthwards, as liquid eddies do, they will, by forcing the air downwards, tend to elevate the barometric mercurial column, not depress it. If these wind-whirls eddy upwards they will tend to originate and evolve aerial "mounds" skywards, not pits. If not, why not ? in both cases.

The quotation from Sir John Herschel does not state what originates the "*wind*" driven over mountain ranges, which is what is wanted. If the air never varies in density or velocity I do not see that the range crossed will break it into very perceptible waves ; but, granted that it does so, then the undulations will be generated continuously, like waves in the rapids of Niagara, as in the case of diurnal maxima and minima, and we will require some other *fitful* originator of cyclonic disturbances, which occur only occasionally.

Waiting Mr. Ryves' next letter,

I am, &c.,

HENRY MUIRHEAD.

Cambuslang, 17th May.

SIR,—Being neither a meteorological authority, such as Mr. Ryves or Dr. Muirhead would invoke, nor a worshipper of any principality, I can offer no opinion here on the controversy concerning “depressions” to which your correspondents would attach any value. Neither shall I deal in this letter with the origin of terms or expressions, interesting as this may be to the historian of science after his kind, or to the etymologist and lexicographer after their kind. But is it not a little hard upon students of meteorology that we should have pages of correspondence on a necessarily much-studied branch of our subject, practically treating that branch as if it were nearly new. Projects of ventilation are useful in their way, and it is, in general, a pity that we get so little of them; but on well-exposed rising ground, under a strong breeze they seem slightly out of place. Now, after full attention has been devoted to the works of Faye, Hazen, and other oppositionists, the fact remains that the character of the current of scientific theory, on the subject vaguely treated of by your correspondents, is strong enough to be, to most of us, unmistakable. Whether, in the present state of our knowledge, Sir John Herschel would be grateful for the reference made to a statement of his, or whether living writers will be grateful for inferences drawn from their works, is a point with which we are not concerned. Beyond other varieties of the human species we (students of meteorology) suffer long and are very kind. But there is a limit even to our tender-heartedness, the probable position of which limit I should like to indicate.

What would be thought of the airing of, say, the subject of “Panmixia” in the pages of a biological periodical, without any reference to the works of, *e.g.*, Prof. Weismann? In dealing with a subject on which many authors might advantageously be referred to, it may seem invidious to mention only one. But I shall, as your correspondents give to great names the honour really due to them, mention one, and, for the sake of brevity, one only. I do not claim for Mr. Ferrel the title which he is himself, I believe, anxious to repudiate, of “the Newton of Meteorology,” and I even consider that certain of his conclusions require, and will receive (I hope at his own hands) some modification. But I must ask whether correspondents have or have not, studied Ferrel’s “Researches,” “Recent Advances,” or, in any case, his latest “Popular Treatise on the Winds.” If not, they are writing on a subject to which they have given inadequate attention. And, on either supposition, they should be aware, and show themselves to be aware, that many of your readers, and (as I hope) many Fellows of the Royal Meteorological Society, possess and employ sources of information—such as those I have alluded to—which cannot with safety be utterly ignored.

I am, sir, yours very faithfully,

W. CLEMENT LEY.

May 20th, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCT., 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	60·6	16	35·5	13	55·9	43·1	45·1	88	96·8	31·8	3·75	22	7·1
Malta	84·8	26	58·0	17	78·6	66·3	63·3	78	135·5	51·7	·65	3	3·8
Cape of Good Hope. ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	79·0	16a	63·6	1	78·0	66·8	61·7	72	135·8	55·7	1·20	21	5·4
Calcutta	90·4	1	64·7	31	86·4	74·7	75·1	84	156·0	58·1	5·76	9	4·6
Bombay	92·2	13	70·0	29	86·5	75·5	73·5	79	143·0	60·1	3·80	7	4·9
Ceylon, Colombo	87·4	6	72·0	...	85·6	76·1	71·1	76	150·0	63·5	14·99	19	6·2
Melbourne	84·5	14	37·8	12	67·7	50·7	48·7	70	144·9	30·7	2·86	11	6·7
Adelaide	88·1	22	42·0	9	73·3	53·7	50·8	63	144·2	34·8	3·61	12	5·3
Wellington	68·0	30	41·0	26, 27	61·2	47·8	46·1	74	127·0	34·0	3·20	16	3·9
Auckland	74·0	31	47·0	13	64·7	51·6	49·8	74	135·0	35·0	3·20	11	5·2
Jamaica, Kingston	93·8	8	67·8	5	89·7	71·2	71·9	76	...	...	4·20	...	...
Trinidad	91·0	7b	66·0	25, 26	89·0	70·4	72·5	77	159·0	60·0	6·30	19	...
Toronto	61·5	1	22·6	24	49·8	35·6	34·9	73	...	9·8	1·89	14	6·6
New Brunswick, Fredericton	60·1	1	16·8	24	50·1	34·5	38·4	83	...	...	5·17	13	6·5
Manitoba, Winnipeg ...	72·5	10	8·5	22	49·5	27·6	33·0	78	...	...	·86	10	5·5
British Columbia, Victoria	67·0	4	36·0	15	58·7	48·9	...	...	...	...	2·08	16	...

a And 28, 31.

b And 25, 26.

REMARKS, OCTOBER, 1889.

MALTA.—Mean temp. 71°·0; mean hourly velocity of wind 9·2 miles. Sea temp. fell from 77°·5 to 72°·0. TS on 17th, L on 20th and 31st. J. SCOLES.

Mauritius.—Mean temp. of air equal to, of dew point 0°·2 above, and E·70 in. below, their respective averages. Mean hourly velocity of wind 11·6 miles, or 0·2 mile below average; extremes 30·5 on 4th, and 1·9 on 1st. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—L seen on 1st and 2nd.

J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 2°·2, of dew point 2°·5, amount of cloud 0·7, and E·06 in. above the average. Prevailing winds N. and S., strong on 7 days. Heavy dew on 7 days; TS on 4th. R. L. J. ELLERY, F.R.S.

Adelaide.—Another wet month, E being 2½ inches in excess of the average of 32 years; the total since January 1st (28·43 in.) is the greatest on record for a similar period since 1839. Bar. about an average, and mean temp. 1°·6 above average. C. TODD, F.R.S.

Wellington.—Showery during the early part of the month, and at intervals up to the 26th, then fine for the remainder. Prevailing N.W. wind, and stormy on 20 days from that quarter. R. B. GORE.

Auckland.—Early part of the month stormy and rainy; middle and close fine and dry. Bar. pressure, mean temp., and E, all close to the average, but slightly above. T. F. CHERSEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, MAY, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	1.58	XI.	Castle Malgwyn	4.22
„	Margate, Birchington...	1.92	„	Builth (Llanwrtyd Wells)	2.35
„	Littlehampton	1.77	„	Rhayader, Nantgwillt..	3.30
„	Hailsham	2.45	„	Carno, Tybrith	2.02
„	Ryde, Thornbrough	2.46	„	Corwen, Rhug	2.49
„	Alton, Ashdell	1.99	„	I. of Man, Douglas	3.21
III.	Oxford, Magdalen Col..	1.75	XII.	Stoneykirk, Ardwell Ho.	2.94
„	Banbury, Bloxham	1.78	„	New Galloway, Glenlee	4.01
„	Northampton	1.60	„	Melrose, Abbey Gate ..	1.62
„	Cambridge, Fulbourne..	1.89	XIII.	N. Esk Res. [Penicuik]	2.05
„	Wisbech, Bank House..	2.30	XIV.	Ballantrae, Glendrishalg	2.86
IV.	Southend	1.50	„	Glasgow, Queen's Park.	2.75
„	Harlow, Sheering	...	XV.	Islay, Gruinart School..	1.69
„	Rendlesham Hall	1.61	XVI.	Dollar	1.27
„	Diss	1.86	„	Balquhiddy, Stronvar..	3.28
„	Swaffham	2.03	„	Dunkeld, Inver Braan..	2.41
V.	Salisbury, Alderbury...	...	„	Dalnaspidal H.R.S.	3.43
„	Warminster	2.01	„	Arbroath Cemetery	..
„	Bishop's Cannings	1.82	XVII.	Keith H.R.S.	1.51
„	Ashburton, Holne Vic....	2.71	„	Forres H.R.S.	.56
„	Hatherleigh, Winsford.	2.01	XVIII.	Fearn, Lower Pitkerrie.	.96
„	Lynmouth, Glenthorne.	...	„	Loch Shiel, Glenaladale	3.62
„	Probus, Lamellyn	4.43	„	N. Uist, Loch Maddy ...	1.16
„	Launceston, S. Petherwin	2.50	„	Invergarry	2.97
„	Wincanton, Stowell Rec.	1.64	„	Aviemore H.R.S.	1.22
„	Taunton, Lydeard Ho....	1.90	„	Loch Ness, Drumnadrochit	1.21
„	Wells, Westbury	1.48	XIX.	Lairg H.R.S.	1.05
VI.	Bristol, Clifton	1.87	„	Scourie	.99
„	Ross	2.12	„	Watten H.R.S.	1.83
„	Wem, Clive Vicarage ...	1.92	XX.	Dunmanway, Coolkelure	5.49
„	Cheadle, The Heath Ho.	2.10	„	Fermoy, Gas Works ...	3.91
„	Worcester, Diglis Lock	1.98	„	Tipperary, Henry Street	3.75
„	Coventry, Coundon	2.47	„	Limerick, Kilcornan ...	2.75
VII.	Ketton Hall [Stamford]	2.53	„	Milton Malbay	3.89
„	Grantham, Stainby	2.72	XXI.	Gorey, Courtown House	3.29
„	Horncastle, Bucknall ...	2.10	„	Navan, Balrath	1.76
„	Mansfield	...	„	Mullingar, Belvedere...	2.98
VIII.	Neston, Hinderton	1.71	„	Athlone, Twyford	2.01
„	Knutsford, Heathside ...	2.18	„	Longford, Currygrane...	2.06
„	Lancaster, South Road.	2.62	XXII.	Galway, Queen's Coll....	2.39
„	Broughton-in-Furness ..	3.82	„	Clifden, Kylesmore	3.86
IX.	Wakefield Prison	2.30	„	Crossmolina, Enniscoe..	2.27
„	Ripon, Mickley	2.52	„	Collooney, Markree Obs.	1.37
„	Scarborough, West Bank	2.61	„	Ballinamore, Lawderdale	...
„	East Layton [Darlington]	2.29	XXIII.	Warrenpoint	1.62
„	Middleton, Mickleton..	1.92	„	Seaforde	1.72
X.	Haltwhistle, Unthank..	1.63	„	Belfast, New Barnsley ..	2.16
„	Shap, Copy Hill	3.40	„	Bushmills, Dundarave...	1.79
XI.	Llanfreccha Grange	...	„	Stewartstown	1.86
„	Llandovery	2.08	„	Buncrana	1.56

MAY, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which "or more fell.	TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Dpth.	Date.		Max.		Min.			
				inches.	in.				Deg.	Date	Deg.	Date	In shade.	On grass.
I.	London (Camden Square) ...	1.25	—	.65	.41	9	13	77.6	25	39.1	31	0	0	
II.	Maidstone (Hunton Court)...	1.61	+	.28	.55	10	12	...	...	...	...	...	...	
III.	Strathfield Turgias	2.18	+	.31	.78	9	12	78.2	24	34.6	31	0	8	
III.	Hitchin	1.92	—	.08	.56	10	11	72.0	24a	38.0	1	0	...	
IV.	Winslow (Addington)	2.00	—	.10	.40	9	13	78.0	24	33.0	31	0	6	
IV.	Bury St. Edmunds (Westley)	2.26	+	.51	.85	10	8	...	...	...	...	...	...	
V.	Norwich (Cossey)	1.57	—	.10	.54	9	7	...	...	...	...	...	...	
V.	Weymouth (Langton Herring)	1.74	+	.18	.31	16	12	76.0	25	41.0	28f	0	...	
"	Barnstaple	2.76	+	.56	1.05	26	15	79.0	25	38.0	28	0	...	
"	Bodmin (Fore Street)	5.04	+	2.51	1.40	8	19	...	...	...	...	...	...	
VI.	Stroud (Upfield)	2.06	+	.02	.84	9	14	78.0	25	35.0	30	0	...	
"	Churchstretton (Woolstaston)	2.76	—	.11	.56	19	18	71.0	24	37.0	31	0	1	
"	Tenbury (Orleton)	2.22	—	.33	.66	19	14	76.3	24	33.0	31	0	3	
VII.	Leicester (Barkby)	1.85	—	.12	.45	10	14	78.0	24	29.0f	27	4	12	
"	Boston	2.04	+	.32	.75	10	12	80.0	22	33.0	1, 31	0	...	
VIII.	Hesley Hall (Tickhill)	2.61	+	.57	.53	10	12	76.0	24	33.0	1	0	...	
IX.	Manchester (Plymouth Grove)	2.32	—	.03	.68	29	10	78.0	24	39.0	26g	0	0	
IX.	Wetherby (Ribston Hall) ...	2.07	+	.12	.48	12	8	...	...	...	...	...	...	
"	Skipton (Arncliffe)	3.43	—	.29	1.02	16	14	75.0	24	33.0	11	0	...	
"	Hull (People's Park)	3.05	+	1.17	.78	10	14	...	...	...	...	...	...	
X.	North Shields	1.68	+	.07	.50	11	14	68.5	12b	32.0	31	1	1	
X.	Borrowdale (Seathwaite)	7.96	—	.65	1.60	16	16	...	...	...	...	...	...	
XI.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...	...	
"	Haverfordwest	4.54	+	2.18	1.18	15	19	77.6	24	34.8	30f	0	4	
"	Plinlimmon (Cwmsymlog) ...	1.74	...	...	.36	15	11	...	...	...	...	...	...	
XII.	Llandudno	1.91	—	.02	.42	16	12	74.0	24	43.3	27	0	...	
XII.	Cargen (Dumfries)	3.18	+	.66	.91	11	15	73.8	23	33.6	31	0	...	
XIV.	Jedburgh (Sunnyside)	1.49	—	.41	.48	8	11	72.0	23	32.0	14	1	...	
XIV.	Old Cumnock	3.28	+	.84	.33	11	17	76.0	24	26.0	30	1	...	
XV.	Lochgilphhead (Kilmory)	2.45	—	.90	.70	16	16	...	...	...	...	...	...	
"	Oban (Craigvarren)	2.77	...	...	.68	29	20	75.2	25	39.3	27	0	...	
"	Mull (Quinish)	2.07	—	.88	.54	16	17	...	...	...	...	...	...	
XVI.	Loch Leven Sluices	1.60	—	.96	.40	12	8	...	...	...	...	...	...	
XVII.	Dundee (Eastern Necropolis)	2.10	+	.44	.65	16	10	70.6	23	34.8	27	0	...	
XVII.	Braemar	2.16	—	.25	.55	5	18	73.0	25	28.2	2	2	7	
XVIII.	Aberdeen (Cranford)	3.40	...	...	.80	15	20	72.0	21	38.0	1, 3a	0	...	
XVIII.	Strome Ferry	1.98	—	1.37	.46	14	15	...	...	...	...	...	...	
"	Culloden	.68	—	.32	...	...	...	71.0	24	38.0	15	0	7	
XIX.	Dunrobin	1.42	—	.68	.42	16	16	66.0	24	37.0	30	0	...	
"	S. Ronaldsay (Roeberry)	...	...	...	...	...	...	...	...	...	...	...	...	
XX.	Cork (Blackrock)	3.85	+	1.45	.54	17	21	69.0	23c	29.0	3, 12	0	...	
"	Dromore Castle	5.67	+	1.99	.90	2	21	72.0	25	38.0	3	0	...	
"	Waterford (Brook Lodge) ...	3.19	+	.96	.50	17	18	72.0	24	36.0	3	0	...	
"	O'Briensbridge (Ross)	1.90	...	...	.31	18	18	71.0	31	38.0	1	0	...	
XXI.	Carlow (Browne's Hill)	2.85	+	.51	.47	15	19	...	...	...	...	...	...	
XXII.	Dublin (Fitz William Square)	2.44	+	.51	.46	3	17	65.7	23	39.1	31	0	0	
XXII.	Ballinasloe	1.65	—	1.04	.17	6, 19	20	67.0	24d	32.0	31	1	...	
XXIII.	Waringstown	1.68	—	.76	.36	29	17	76.0	24d	34.0	2	0	1	
"	Londonderry (Creggan Res.) ..	1.82	—	.70	.66	29	18	...	...	...	...	...	...	
"	Omagh (Edenfel)	1.75	—	.72	.45	29	17	68.0	3e	35.0	31	0	...	

b And 22. c And 24, 28. d And 25. e And 24, 25. f And 31. g And 27, 30. h And 30.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON MAY, 1890.

ABBREVIATIONS.—*Bar.* for Barometer; *Ther.* for Thermometer; *Max.* for Maximum; *Min.* for Minimum; *T* for Thunder; *L* for Lightning; *TS* for Thunderstorm; *R* for Rain; *H* for Hail; *S* for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A fine May with sufficient changes of heat and cold and wet and dry to maintain the fickle character of the month. Horse Chestnut in flower on the 8th, pink lilac on the 10th, laburnum on the 18th, small white butterfly flying on the 1st, orangetip butterfly on 17th.

ADDINGTON.—Beautiful weather from 1st to 3rd, and 22nd to 30th; nights generally cold throughout. Potatoes and kidney beans blackened by frost on the 31st. *T* on 7th, 11th and 19th; on 19th .25 in. of *R* fell in 12 minutes.

BURY ST. EDMUNDS.—The month was favourable for agriculture, frosts being slight and few. A magnificent *TS* occurred on the evening of the 19th, with heavy rain, .54 in.

LANGTON HERRING.—*R* of May about the average, but for the first five months of the year, 10 per cent. below the average. The mean temp. at 9 a.m., 55°·4, was 1°·7 above the average. Only once in 18 years did the temp. in May reach 75°, while this year it reached 74° on the 23rd and 24th, and 76° on the 25th, on which day there was a violent *TS*. *T* also on 8th and 24th. Solar halos on 2nd, 7th and 29th.

BODMIN, FORE STREET.—A very cold and wet month. Two very hot days, the 24th and 25th, on the latter day a *TS* occurred about 7.30 p.m., with a downpour of *R*, .15 in. falling in a few minutes.

STROUD, UPPFIELD.—*T* heard on 2nd, 11th 19th, and 20th; *L* seen on 19th and 25th.

WOOLSTASTON.—A genial growing month. Frequent *T* and *L* during the first week. Mean temp. 52°·2. *H* on 14th.

ORLETON.—A pleasant month, with fewer cold days than usual, the mean temp. being 1°·6 above the average of 29 years. *T* and *L* on 2nd, 6th, and 19th, with very heavy *R* from 8 to 9.30 p.m. on the latter date.

MANCHESTER, PLYMOUTH GROVE.—A very fine month. Summer weather from 21st to 25th. Cold winds from 26th to 31st. Prevailing wind, S.E.; mean temp. 55°·1; *L* on 12th.

ARNCLIFFE.—A dry month, half the *R* falling on two nights, 11th and 16th.

WALES.

HAVERFORDWEST.—The wettest month of the year, except January. No frost in the shade. Continual *R* up to the 20th, especially heavy from the 15th to the last mentioned date, after which a sudden burst of great heat prevailed, followed by a *TS* of great intensity on the 25th. The storm fell with its greatest violence to the N.W. and N. of the county, accompanied by a deluge of *R*, while at Haverfordwest only .02 in. fell. The month ended fine, but with a great and sudden fall of temp. after the great storm. Wind principally from S.E. throughout the month.

SCOTLAND.

CARGEN.—Mean temp. of the month (52°·9) 2°·2 above the average. Some very cold nights were experienced towards the end of the month and on the morning of the 31st potatoes were partially frosted down. The extremes between day and night temp. were often great, the range on the 28th being 33° in about 12 hours. Easterly winds prevailed for 17½ days; sunshine just the average for the month. *T* and *L* on 6th and 18th, *T* on 7th.

JEDBURGH.—Much N.E., N.E., and S.E. wind with little sunshine. Grass and cereal crops thrive, and the blossom on fruit trees was remarkably abundant.

ORAN.—A fine growing month, warm, with an ample sprinkling of showers.

CULLODEN.—Another very dry month; cereals progressing well.

IRELAND.

CORK.—On the whole a pleasant month with spells of showery weather, which were very favourable to vegetation. No frosts. Mean temp. $53^{\circ}3$, $0^{\circ}5$ below the average of 14 years.

WATERFORD, BROOK LODGE.—T and L on the 24th, T on the 25th.

ROSS, O'BRIENSBRIDGE.—A beautiful month; no frost; abundant and brilliant sunshine; wind moderate, mostly N.E. T and L on 20th and 21st.

DUBLIN.—Although changeable and generally showery, the month was favourable from a public health point of view, and from that of agriculture. Until the 20th E fell in frequent showers; after that date, however, a succession of bright, spring-like days occurred, giving a wonderful impetus to vegetation. Mean temp. $52^{\circ}8$. Lunar halo on 31st. Fog on 16th. High winds on 10 days, H on 14th, L on 24th.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, May the 21st at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. W. Friese-Greene and Mr. F. H. Phillips were elected Fellows of the Society.

The following papers were read:—

(1). "Rainfall of the Globe," by Mr. W. B. Tripp, M.Inst. C.E., F.R.Met.Soc. This was a comparative chronological account of some of the principal rainfall records. The earliest record quoted is that of Paris, which commenced in 1689. The English records are taken from 1726. The rainfall observations in the southern hemisphere do not extend over a very long period; at Adelaide they were commenced in 1839, but they do not go back further than 1866 for New Zealand. The greatest fall in any particular year at the stations given by the author was 160.9 in. at St. Bernard, in 1839, and the least 3 in., at Sandiego, in California, in 1863. By combining the stations in the northern and southern hemispheres, the author finds that in recent times the years with the highest average rainfall were 1878, 1879, and 1883, and the years with the lowest average were 1854 and 1861.

(2). "Mutual influence of two pressure plates upon each other, and comparison of the pressures upon small and large plates," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

(3). "On the variations of pressure caused by the wind blowing across the mouth of a tube," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

In these two papers the author gives the results of some experiments on wind pressure which he has made, mostly on the whirling machine at Hersham, Surrey. From these experiments it seems probable that a decrease of pressure per square foot, with an increase of size of plate, may be taken as a general rule.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCIV.]

JULY, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

REVIEWS.

Handbook of Meteorological Tables. By H. A. HAZEN, M.A., Assistant Professor, Signal Office. Washington, D.C. 1888. 8vo., viii. 128 pages.

WE have often heard of this volume, and are very glad to offer it a welcome on this side of the Atlantic.

Prof. Hazen by no means intends to supersede Guyot's most valuable collection, but as a practical worker he knows which tables have been most useful to himself, and in this handbook he not merely tells us what he has found useful, but he supplies every one with a copy. Like most meteorologists, he has been obliged to calculate some fresh tables for himself, and these he very properly distinguishes as "Original."

As nearly all the tables are given in duplicate, *i.e.*, both in English and in Metric values, the volume will be nearly as useful on the Continent as in America and in England, and we are rather puzzled at no publisher's name appearing on the title page, for to print a work like this is a serious matter, and one would have supposed that the author would have arranged to partly cover his outlay by its sale. There are certainly not many meteorologists who could afford to print, and to give away the whole edition of such a volume of tabular matter. It may be that he has reserved the sale to himself instead of placing the volume in the hands of any publisher, if so, some intimation of the fact, and of the price would be useful. We are not in the habit of presenting either authors or publishers with advertisements gratis, but in this case we feel that the matter ought to be cleared up, and we shall gladly insert any brief statement with which Prof. Hazen may favour us, because we feel that he must have made a considerable sacrifice to prepare and print such a volume, and that that sacrifice merits recognition at the hands of meteorologists.

Having intimated our general approval of the volume, we need only give an idea of its arrangement and contents, and point out the respects in which we think that it falls short of perfection.

It contains seven tables (conversion, &c.), relating to temperature,

nine to pressure, seven to humidity, six to wind, six to linear measures (inches into millimetres, &c.), and ten miscellaneous ones.

In the way of criticism we have little to say. There is perhaps some uncertainty or unevenness in the author's desire for precision. On p. iv., he tells us that in all the linear tables the latest value for the metre 89·3702 in., has been used, instead of the old one of 39·3709, but this is only a difference of 1 in 56209, or less than 0·001 in. in any barometric reading, and about 1 in. in a mile, a refinement far in advance of meteorology at present—and yet in Table XII., he (wisely we think), gives the barometer to hundredths of an inch only.

In the section for linear measures there is by far the best table for inches into millimetres we have ever seen; it gives the equivalent of each hundredth of an inch from 0·01 in. to 31·99 in.; but for the reverse process millimetres into inches, the table extends only from 400^{mm.} (15·748 in.), to 800·9^{mm.} 31·532 in.). We presume that Prof. Hazen when sending it to press, was thinking solely of barometric conversions, and forgot that the table if carried down to 1^{mm.} and up to 1000^{mm.} (i.e. 1 metre), would be very valuable for rainfall work. We computed a skeleton one of this kind years ago, but have never printed it on account of the expense. We know that it seems greedy to wish for twelve pages of additional tables, but if that were too much, we would have sacrificed the 100^{mm.} between 400 and 500^{mm.} and given a two-page table with the equivalent of each ^{mm.} (not each 0·1^{mm.}) from 1 to 1000^{mm.}.

There is a splendid table, metres into feet, going by *each metre* from 1 metre to 4009^{m.} (say 2½ miles), but we do not get feet into metres; and oddly enough the reverse occurs with miles and kilometres which we have, though kilometres into miles we have not.

One practical illustration is worth much talk. Our readers may remember that in our February number of this year, we had a remarkable record of drought from Col. Ward, to which we added some others from India and elsewhere. One of the records was so extreme (45° between the dry and wet bulb), that we could find no table to give the humidity. Prof. Hazen's tables give it at a glance.

They are unquestionably valuable helps which must be kept handy, and replaced when worn out.

Sur la température nocturne de l'air à différentes hauteurs. Par JULIUS JUHLIN. (Présenté à la Société Royale des Sciences d'Upsal le 27 Avril, 1889). E. Berling, Upsal, 1890. 4to, 24 pages.

It is a pity that some form of engraving is not more frequently employed on the Continent. This is an excellent little paper, but the facts would have been much more readily followed, and more permanently impressed, had the tabular values been given also as diagrams, and had there been a sketch of M. Juhlin's mast, and a

rough map showing the various localities in and near Upsala, referred to in the Memoir. Section IV., "On the influence of the soil on the temperature of the air," cannot be read with advantage by any one who is not, either provided with a map of the city, or well acquainted with its topography.

The paper is divided into four sections. In the first the author gives short accounts of the experiments upon the variation of temperature with height above the soil, made by Pictet (1778), Six (1784), Wells (1814), Marcet (1837), Lottin and Bravais (1838), Plantamour (1847), Charles Martins (1858), Prestel (1858), K. Fritsch (1861), Glaisher (1868), Wild (1872), Marie Davy (1874), Hamberg (1875), and Marriott (1882). This section is rather aggravating, because, although the brief descriptions of the nature of the experiments are interesting, the author rarely states what were the results obtained. Having taken the trouble requisite to collect the descriptions, very little more would have enabled him to add greatly to the value of the paper.

The author naturally, and very properly, calls special attention to the experiments made at Upsala in the summer of 1875 by a volunteer band of twenty university students, under the direction of M. Hamberg, and says that his researches are to be regarded as supplementing those made by M. Hamberg in summer; those by M. Juhlin being in winter, and when the ground was covered with snow. He also gracefully acknowledges help received from Prof. Hildebrandsson, and his profound gratitude to Dr. N. Ekholm, and to two students (MM. Falk and Vallner), who, as he says, "have sacrificed for me their time and their nightly rest in helping me with these fatiguing observations." We supplement this by pointing out that it was not merely for M. Juhlin that these gentlemen spent night after night in the bitter frost and snow, taking the hourly readings of the various thermometers. It was, like every bit of honest, scientific work, done to increase man's knowledge of the world in which he lives—something which will last long after those who have done it have passed away.

Years ago we ourselves had a pole about the same height as that employed at Upsala (22ft.), and a complete set of thermometers at the top. In time of frost and snow, when (at 9 p.m.) we found ourselves with the readings all entered, and ourselves and our lantern safely on *terra firma*, it was always with a feeling of great thankfulness; and with six thermometers on the mast, much snow, and temperatures below zero Fahrenheit, these gentlemen must certainly have had a rough time of it. It is a great pity that there is no sketch showing how the thermometers were arranged, and how access to them was obtained for reading. One also wants to know, if all were on one mast, whether the observer read them when climbing, and again in descending, and whether his presence and that of the lamp did or did not affect the readings.

The author's summary is as follows :—

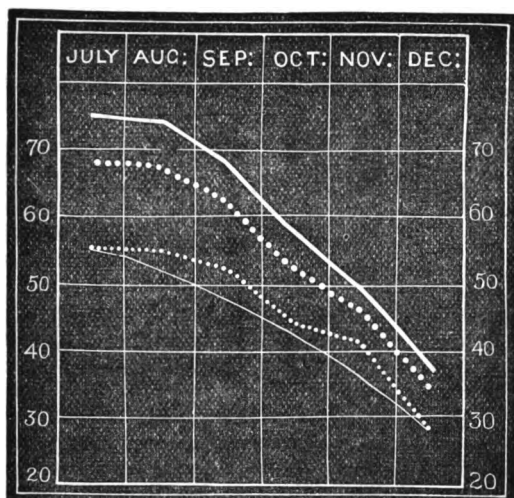
1. The decrease of temperature, due to radiation from exposed thermometers, is almost constant at all heights (above a snow surface), greater than 20 inches.
2. During clear winter nights the temperature increases with height; this begins about two hours before sunset, and lasts until about two hours after sunrise.
3. The increase of temperature with height is greater in winter than in other seasons.
4. The increase of temperature with height is a linear function of the temperature, so that the lower the temperature the more rapid is the increase.
5. During overcast and misty nights in winter there is little variation with height.
6. The variation of temperature [with height.—ED. *M. M.*] follows very closely the amount of cloud.
7. A veil of thin and high clouds diminishes but slightly the variation of temperature with height.
8. In winter the surface of snow is colder than the air around it.
9. The fact that snowy winters have usually hard and long frosts is easily explained by the physical properties of snow.
10. During winter nights the temperature on hills and lofty edifices is higher than on low ground.

We may appropriately supplement this notice with a few words respecting the temperature observations made upon the Eiffel Tower between July and December last, of which an abstract was given by M. Angot, at the Soc. Mét. de France, on the 4th of February last. He gives the following values :—

	EIFFEL TOWER				PARC ST. MAUR.				DIFFERENCES.			
	Mean.	Max.	Min.	Range	Mean.	Max.	Min.	Range	Mean.	Max.	Min.	Range.
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.
July.	61·2	67·3	55·2	12·1	64·1	75·4	55·2	20·2	-2·9	-8·1	0·0	-8·1
Aug.	60·3	67·0	54·5	12·5	62·2	74·1	52·8	21·3	-1·9	-7·1	+1·7	-8·8
Sept.	56·3	61·9	51·4	10·5	56·8	67·8	47·9	19·9	-5	-5·9	+3·5	-9·4
Oct.	47·8	52·4	44·2	8·2	49·1	57·9	43·0	14·9	-1·3	-5·5	+1·2	-6·7
Nov.	43·2	45·9	40·3	5·6	42·6	49·1	36·6	12·5	+·6	-3·2	+3·7	-6·9
Dec.	30·7	34·4	27·9	6·5	32·5	37·0	28·6	8·4	-1·8	-2·6	-·7	-1·9
Mean	49·9	54·8	45·6	9·2	51·2	60·2	44·0	16·2	-1·3	-5·4	+1·6	-7·0

These values will be much more readily followed in a diagram, which we therefore give. The solid lines represent the values at the surface (Parc St. Maur), the dotted lines those at the top of the Eiffel Tower. Hence we see that the temperature at the top is much more equable than at the surface. As regards the maxima, the excess of heat at the surface (nearly 10° in summer) is doubtless due

to the heat rays passing through the atmosphere without producing much effect, but heating the soil directly they reach it, and so heating the stratum of air near to it. The difference at night was less marked, but there again the soil accentuates the temperature change, because it is a better radiator than air, and, therefore, while itself cooling, it cools the air in its proximity.



“AREAS OF RAREFACTION” OR “DEPRESSIONS.”

To the Editor of the Meteorological Magazine.

SIR,—In reference to the intervention of Mr. Ley in this correspondence, I have only to say that if the question is one which has passed out of the stage of ventilation or discussion, and “the character of the current of scientific theory on the subject is so strong as to be unmistakable,” it is a pity that Mr. Ley did not, from his point of vantage, “on the well-exposed rising ground under a strong breeze,” vouchsafe some little help and guidance to the befogged and bewildered wanderers in the valley below. This would, I think, have been more in keeping with that “long-suffering kindness” which, he tells us, is a characteristic of the student of meteorology, than simply to upbraid us with our ignorance without favouring us with one ray of enlightenment. I cannot, however, accept Mr. Ley’s view that this is a question on which only experts are entitled to be heard, and, therefore, though I have not had the advantage of studying Ferrel and “the Oppositionists,” and at the risk of exhausting Mr. Ley’s “tender-heartedness” and bringing upon myself I know not

what terrible penalty in consequence, I will now, with your permission, state as briefly as I can some facts which seem to me to go far to justify the view which I maintain, viz., that the differences observable in the height of the barometric column, at the same level at different times, and in different places at the same time, correspond to real differences in the height of the aerial column above it, and not merely to differences in the density of the air.

(I.) We know that in the equatorial regions, under the influence of the solar heat, and the indraft and pressure of cooler air from higher latitudes, enormous volumes of warm air are constantly rising to a great height and flowing over on both sides of the equator towards the poles. Let us suppose some exceptionally energetic outflow of this kind to extend some distance to the north of the equator spreading out laterally at the same time, as it would naturally tend, to do, and it is obvious that we should have over the region beneath it an area of high pressure, *not because the air there was more dense* (except in so far as the addition of another stratum of air above would tend in some degree to increase the density of those upon which it was superimposed), but because there was *more air, i.e., a greater depth of air* than over the adjacent regions. If, now, we suppose two such outflows of equatorial air spreading northwards or north-eastwards, with an interspace between them, it is obvious again that in this interval we shall have an area of relatively low pressure, *not because the air there is less dense or more rarefied*, but because there is a less depth of air there than in the regions around it.

Once more, if we suppose a number of such waves or streams of air, with interspaces between them, to flow over from the equatorial regions about the same time, and, setting out at points some distance to the westward of our meridian, to extend as far north as these latitudes, it is plain that (making allowance for the easterly trend of volumes of air flowing from the equator northwards), we might expect them to pass over us as bands of alternate high and low pressure—"anti-cyclonic bands or ridges" and "troughs of low pressure," or "elongated depressions"—moving in a N.E. direction, a condition of things which we know, from the evidence of our weather charts, *does*, in fact, prevail not infrequently over our islands and their neighbourhood.

It is not suggested that the "cup-like" depressions on the one hand or the anti-cyclonic "mounds" on the other extend to the extreme upper surface of the atmosphere, variously estimated at from 50 to 200 miles. It may be safely assumed that at the lowest of these limits the air would know as little of such disturbances as the bottom of the ocean knows of the storms and currents which disturb its surface. For practical purposes, in relation to pressure, wind, cloud, vapour, heat, everything, in fact, except the reflection and refraction of light, the atmosphere may be considered to terminate at a height of 20 miles at the outside, and it is within that limit that I suppose all the movements and changes which affect the height of

the barometer to occur. Here, then, it seems to me that we have a *vera causa* which, taken in conjunction with the modifying influences of the rotation of the earth, the distribution of land and water, the configuration, contour, and elevation of the land, and possibly electricity and magnetism, will go a long way towards accounting for the differences of pressure indicated by the barometer.

(II.) On the other hand, that differences of atmospheric pressure cannot be accounted for by the supposition of differences of temperature is shown by some recent observations made by Dr. Hann at high altitudes, and communicated by him to the Academy of Sciences at Vienna on April 17th. During the great anti-cyclone which prevailed over Central Europe, including the Alpine District, in November last, Dr. Hann was able to employ observations up to a height of above 10,000 feet, and found that the depression of temperature which accompanied the anticyclone was limited to a few hundred feet above the earth, while on October 9th and 10th, during a barometrical minimum, he found that the temperature at the summit of the Sonnblick was lower than during the barometrical maximum above referred to; and as the result of these observations and others of the same nature, he comes to the conclusion, 1st, that "in barometrical maxima the conditions of pressure are not explained by conditions of temperature, but are a consequence of the movement of the air," and 2nd, that, whereas "until the establishment of mountain stations the temperature was assumed to be one of the chief causes of the form of motion of cyclones and anticyclones, future enquiries must take into account that at least up to 4 or 5 kilometres the temperature at the centre of an anticyclone may be, and probably always is, higher than in the centre of a cyclone."—See *Nature*, May 29th, 1890.

I have no cut-and-dried theory to offer in explanation of the origin of low pressure systems. I have simply maintained, in opposition to Dr. Muirhead, that we are not warranted in asserting that they are simply areas "where the air is more rarefied, and, therefore, lighter, *not depressed*," and that, on the contrary, there is some reason to believe that they do correspond to actual atmospheric depressions.

(III.) In reply to Dr. Muirhead's last letter, I have only to say—

1. That having carefully re-read the 3rd paragraph of his letter on page 9 of the February number of the *Meteorological Magazine*, if I have misrepresented him in ascribing to him the view that cyclones are caused by local heat, I think that the mistake was a very natural and excusable one.

2. That I have never denied the general accuracy of his account of the behaviour of the winds in a depression, but that, according to my view, *that* is the result, not the cause, of the depression, and that when a low pressure area is once formed, the effect will be precisely the same as regards the behaviour of the winds within it, whether the low pressure is due to the rarefaction of the air, or to the existence of a cup-like depression over the locality in question.

3. That Sir John Herschel, in the passage of his Essay on the Weather from which I quoted, *does* state what in his opinion originates the *wind* (the italics are his) in the cases described (see pp. 164, 165, 166 of the "Lectures on Scientific Subjects," New Edition, David Bogue, 1880), but the passage was too long to quote. And I may add that I venture to doubt whether his account of the matter, founded as it is in the main on acknowledged physical facts, has been so utterly exploded by recent advances in Meteorology as Mr. Ley would have us believe.

And now, having said my say, I gladly make way for others who may wish to be heard on the subject under discussion, thanking you, Mr. Editor, for your courtesy in allowing me to explain myself so fully, and not without hope that before the discussion is closed, some of the many readers of the Magazine who, as Mr. Ley assures us, "possess and employ sources of information such as those he has alluded to," may be induced to give us the benefit of their superior knowledge. In that case I will promise to act upon the exhortation addressed to Dr. Muirhead and myself by Mr. Ley in the closing sentence of his letter, and to "be aware, and show myself to be aware," that they do possess this advantage over us.

G. T. RYVES.

Tean Vicarage, July 4th, 1890.

To the Editor of the Meteorological Magazine.

SIR,—I imagine that you and your readers will thank Mr. Ley for knocking together the heads of two ignorant scribblers (I am not even a F.R.G.S.) and sending them to learn their lessons. May I point out that I called attention to an unguarded use of the term "depression" in weather bulletins, as misleading the "general public." Mr. Ryves essayed to show that I was mistaken, and I defended my position. With thanks to Mr. Ley—Yours,

HENRY MUIRHEAD.

PRESSURE ANEMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—At page 55 of the *Meteorological Magazine* Dr. Black compares an anemometer pressure plate 3 feet square with one 30 feet square, and rightly states the ratio of the areas, as 1 to 100 and of the perimeters as 1 to 10; and says, "Therefore, the small plate anemometer must always indicate 2—3 times more pressure than the large one." I fail to understand this deduction.

He proceeds to give another: "From this it will follow that a more suitable form of plate anemometer would be the circular one, while the lengths of the borders would be more approximate to the areas inside them in both large and small gauges." This is neither

a logical deduction nor a true statement of fact. If it "followed," no further proof would be necessary, though he proceeds to prove it. Unfortunately the demonstration is quite erroneous. A circular plate 3 feet in diameter and one 30 feet in diameter have their areas in the ratio of 1 to 100, and their perimeters in the ratio of 1 to 10; just as the fore-mentioned square plates have them—not "ratio of border to border and area to area of 1 to 10, so that both large and small anemometers of a circular shape would represent the pressure of the same gale equally anywhere at the same time." It is really a pity that such a beautifully simple deduction is as baseless as the fabric of a dream, and that all the subsequent pretty inferences drawn therefrom are equally unsubstantial.

Faithfully yours,

R. STRACHAN.

11, *Offord-road, N.*, June 9th, 1890.

[We are always glad that errors when they escape us should be pointed out. Our attention having been concentrated on the accurate reproduction of the figures led to our missing the obvious fallacy that 7 is not a tenth of 706, which Mr. Strachan has fortunately pointed out.

The idea running in our mind, and possibly in Surgeon-Major Black's, though he certainly did not express it, was that if the rim produces any special effect (extending inwards for say 6 inches) and be supposed to have an extra pressure, the ratio of this annulus to the total area will decrease with increase of size of plate, and will be less with a circular plate than with a square one of equal area.—ED. M.M.]

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on June 18th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. C. C. Farr, B.Sc., Mr. J. Hall, A.M.Inst.C.E., Mr. C. R. Rivington, and Dr. J. L. Whitehead were elected Fellows of the Society.

The following papers were read :—

1. "On the difference produced in the mean temperature derived from daily maximum and minimum readings, as depending on the time at which the thermometers are read," by Mr. W. Ellis, F.R.A.S. In the publications issued from Greenwich Observatory, the maximum and minimum temperatures are those referring to the civil day from midnight to midnight. At many stations the observers read their instruments only once a day, viz., at 9 a.m., when the reading of the maximum thermometer is entered to the preceding civil day, and the reading of the minimum thermometer to the same civil day. Such

stations are called "Climatological Stations." The author has tabulated the Greenwich maximum and minimum temperatures according to both methods for the years 1886-89, and finds that the climatological maximum and minimum means are slightly in excess of the civil day means.

2. "On the distribution of barometric pressure at the average level of the Hill Stations in India, and its probable effect on the rainfall of the cold weather," by Mr. W. L. Dallas.—The weather over India during January, 1890, was very dry, and in marked contrast to that which prevailed during January, 1889. The distribution of barometric pressure was, however, much the same in both months. The author has investigated the records at the hill stations, and has prepared charts showing the distribution of barometric pressure from both high and low level stations. From the high level charts it appears that the mean barometric gradient in 1889 was rather more than twice that in 1890, and, considering what is known of air movements, even at moderate elevations above the earth's surface, it may be assumed that these differences in pressure were accompanied by large differences of air motion, and if it is also assumed that the evaporation over the Southern Ocean is in all years fairly comparable in amount, the deficiency of rainfall over India in the winter of 1889-90 can be attributed to diminished lateral translation of vapour, owing to sluggish movements in the upper atmosphere.

3. "On the relative prevalence of different winds at the Royal Observatory, Greenwich, 1841-89," by Mr. W. Ellis, F.R.A.S. The author gives the following as the average number of days of prevalence of different winds for the 49 years 1841-89, as derived from the records of the self-registering Osler anemometer:—

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
40	45	27	22	35	106	46	22	22

4. "On some recent variations of wind at Greenwich," by Mr. A. B. MacDowall.

5. "On the action of Lightning during the Thunderstorms of June 6th and 7th, 1889, at Cranleigh, Surrey," by Capt. J. P. Maclear, R.N.—The author examined a number of trees which had been struck by lightning during these thunderstorms, and found that those which were struck before the rain fell were shattered, while those which were struck after the rain commenced were simply scored, with the bark blown off. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This depends on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, NOV., 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.	Aver.	
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.									
England, London	60·3	8	27·8	28	49·5	40·0	41·2	88	97·3	24·4	·89	8	7·0
Malta	79·9	1	49·3	25	69·0	57·2	51·8	74	127·2	42·0	1·10	8	4·1
Cape of Good Hope.	82·0	9	47·0	18	71·8	54·8	...	...	...	...	·50	...	4·9
Mauritius	81·4	24a	64·0	5	79·7	67·6	63·4	73	137·8	55·1	1·78	9	5·7
Calcutta	85·1	8	58·7	30	80·2	66·7	67·4	82	141·5	51·5	3·17	10	3·6
Bombay	89·6	17	66·8	19	84·8	69·8	66·4	70	137·3	52·3	·00	0	0·1
Ceylon, Colombo	87·7	...	71·0	...	85·8	74·5	70·6	77	153·0	62·0	10·29	18	5·4
Melbourne	93·2	20	41·3	12	71·1	52·1	51·6	70	146·6	35·4	4·27	13	5·6
Adelaide	98·0	19	44·6	11	78·2	57·5	50·6	54	149·9	37·5	2·11	9	4·2
Wellington	72·5	23	40·0	30	64·8	49·1	47·1	70	138·0	33·0	·95	8	3·8
Auckland	76·0	27	46·0	16	66·7	53·9	49·4	67	143·0	40·0	1·11	7	5·0
Jamaica, Kingston	92·2	4	66·5	27	89·9	69·7	69·6	73	...	...	·19	...	...
Trinidad	90·0	b	66·0	6	87·5	69·8	72·5	82	154·0	59·0	7·38	22	...
Toronto	56·8	2	16·9	29	43·9	33·2	34·1	81	...	8·0	3·56	20	7·5
New Brunswick, Fredericton	58·7	3	16·9	16	43·4	27·9	29·7	75	...	...	4·16	9	5·9
Manitoba, Winnipeg ...	52·5	8	13·5	28	33·0	13·9	19·6	81	...	...	·72	10	5·2
British Columbia, Victoria	58·0	17	30·0	12,22	52·2	37·9	...	...	...	...	1·76	7	...

a And 28.

b Several days.

REMARKS, NOVEMBER, 1889.

MALTA.—Mean temp., 61°·7; mean hourly velocity of wind, 9·2 miles; sea temp. fell from 72°·0 to 67°·0. L on 5 days. Lunar rainbow on 10th. Waterspout on 11th at midday.

J. SCHOLES.

Mauritius.—Mean temp. of air, 1°·5, of dew point, 0°·7, and E 1·4 in. below, their respective averages; mean hourly velocity of wind, 9·0 miles, or 2·0 miles below average; extremes, 22·8 on 30th, and 1·6 on 26th; prevailing direction, E.S.E.

C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air, 1°·5, of dew point, 3°·1, humidity 3, and E 1·79 in., above average. Amount of cloud 0·4 below average. Prevailing winds, S. and S.W., strong on 7 days. Heavy dew on 11 days. Fog on 13th. TSS on 4 days, and vivid and continuous L on evenings of 9th, 15th, and 26th. H on 17th.

R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure 0·080 in. below, and temp. 0°·8 above, the average of 32 years. E more than double the average; total fall since Jan. 1 greater than any previous record.

C. TODD, F.R.S.

Wellington.—Fine weather up to the 7th, with moderate northerly winds, then showery for two days, followed by fine weather up to 14th, when light rain commenced, and it continued showery until 18th; remainder of the month very fine and dry, but strong N.W. wind from 20th to 25th. E less than a quarter of the average.

R. B. GORE.

Auckland.—A remarkably fine and dry month, the E being much less than half the average, mean temp. exactly the average.

T. F. CHEESEMAN.

TRINIDAD.—E for the month 56 in. above the average of 25 years.

J. H. HART.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, DEC., 1889.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	53·2	17	22·8	29	43·0	33·2	35·2	89	59·2	17·1	1·23	15	6·9
Malta.....	67·5	5	42·9	4	60·8	50·0	47·4	78	117·1	35·0	8·95	18	5·4
<i>Cape of Good Hope</i> ...	93·0	26	49·3	8	74·7	38·1	...	...	...	...	1·50	...	3·6
<i>Mauritius</i>	83·1	21	67·4	18	81·4	70·4	66·5	75	137·4	59·2	2·76	12	5·9
Calcutta.....	80·1	26	51·3	14	76·3	57·1	57·4	74	137·2	43·0	·03	2	1·5
Bombay.....	88·4	22	65·9	4	84·3	68·4	64·3	68	135·2	49·8	·00	0	0·9
Ceylon, Colombo ...	91·2	30	70·0	24	86·5	72·5	69·2	75	150·8	63·0	5·26	10	4·0
<i>Melbourne</i>	99·8	26	47·0	30	74·7	53·7	49·9	61	152·3	38·8	1·52	7	4·9
<i>Adelaide</i>	98·9	13	50·3	24	82·0	57·8	49·9	49	151·0	41·8	·34	3	3·0
<i>Wellington</i>	75·5	4	45·2	14	69·4	53·3	51·7	72	139·0	38·0	2·73	13	4·6
<i>Auckland</i>	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston.....	92·6	2	60·4	29	89·1	65·0	65·7	71	...	...	·01	...	...
Trinidad	88·0	13	68·0	13a	84·8	70·5	70·4	79	155·0	57·0	7·48	19	...
Toronto	56·1	29	3·2	4	40·5	27·9	30·3	82	...	—1·0	4·90	19	7·4
New Brunswick, Fredericton	41·9	2	11·3	16	29·4	10·8	19·2	77	...	...	4·63	17	5·2
Manitoba, Winnipeg ...	37·0	6	26·0	29	18·0	—3·	9·7	94	...	...	1·42	14	6·1
British Columbia, Victoria	51·0	2	27·0	6b	42·4	32·4	...	...	...	...	2·28	11	...

a And 14, 19.

b And 13.

REMARKS, DECEMBER, 1889.

MALTA.—Mean temp. 54°·7; mean hourly velocity of wind 10·2 miles. Sea temp. fell from 67°·0 to 61°·0. TSS on 5th and 28th. R nearly three times the average.

J. SCOLES.

Mauritius.—Mean temp. of air 1°·7, of dew point 1°·4, and R 2·76 in., below their respective averages. Mean hourly velocity of wind 9·2 miles, or 2·1 below average; extremes, 20 miles on 23rd and 0·0 on 19th; prevailing direction, E. by S. to E. by N. T and L on 23rd and 24th, and L on 25th.

C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—TSS on 7th, 8th, and 12th; L on 9th, 10th, 11th and 30th.

J. C. H. CLARKE, Lt. Col. R.E.

Melbourne.—Mean temp. of air 0°·4 above the average of 31 years. Temp. of dew point 0°·8, humidity 4, amount of cloud 0·7 and R ·98 in., below average. Prevailing winds, S. and S.W., strong on 5 days. Heavy dew on 4 days. TSS on 3 days. H on the 20th.

R. L. J. ELLERY, F.R.S.

Adelaide.—Temp. 1°·3 below the average. R less than half the average. Weather generally mild, with no continued hot spells.

C. TODD, F.R.S.

Wellington.—On the whole a stormy month, with frequent strong winds or gales from N.W., and occasional showers. Some fine bright weather occurred towards the latter part. Prevailing wind, N.W. Earthquake felt on the 10th, at 5.34 p.m., sharp, double shock. Temp. 0°·5 above average. R 1·20 in. below average.

R. B. GORE.

TRINIDAD.—R 2·97 in. above the average of 25 years.

J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL, JUNE, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	2·89	XI.	Castle Malgwyn	1·60
"	Margate, Birchington...	2·73	"	Builth (Llanwrtyd Wells)	5·22
"	Littlehampton	2·55	"	Rhayader, Nantgwillt..	2·94
"	Hailsham	2·61	"	Carno, Tybrith ..	2·28
"	Ryde, Thornbrough	2·80	"	Corwen, Rhug	2·45
"	Alton, Ashdell	2·52	"	I. of Man, Douglas	3·78
III.	Oxford, Magdalen Col...	1·51	XII.	Stoneykirk, Ardwell Ho.	3·16
"	Banbury, Bloxham	1·99	"	New Galloway, Glenlee	5·79
"	Northampton	1·59	"	Melrose, Abbey Gate ..	2·64
"	Cambridge, Fulbourne..	1·68	XIII.	N. Esk Res. [Penicuik]	5·75
"	Wisbech, Bank House..	2·45	XIV.	Ballantrae, Glendriahag	5·03
IV.	Southend	2·13	"	Glasgow, Queen's Park.	3·46
"	Harlow, Sheering	...	XV.	Islay, Gruinart School..	5·25
"	Rendlesham Hall	2·27	XVI.	Dollar	3·71
"	Diss	2·17	"	Balquhider, Stronvar..	7·24
"	Swaffham	4·25	"	Dunkeld, Inver Braan..	3·46
V.	Salisbury, Alderbury...	3·15	"	Dalnaspidal H.R.S.	4·65
"	Warminster	3·95	"	Arbroath Cemetery	...
"	Bishop's Cannings	3·41	XVII.	Keith H.R.S.	2·61
"	Ashburton, Holne Vic.	4·06	"	Forres H.R.S.	1·81
"	Hatherleigh, Winsford.	1·93	XVIII.	Fearn, Lower Pitkerrie.	1·61
"	Lynmouth, Glenthorne.	2·26	"	Loch Shiel, Glenaladale	...
"	Probus, Lamellyn	4·13	"	N. Uist. Loch Maddy ...	5·46
"	Launceston, S. Petherwin	2·87	"	Invergarry	4·56
"	Wincanton, Stowell Rec.	3·77	"	Aviemore H.R.S.	2·31
"	Taunton, Lydeard Ho.	...	"	Loch Ness, Drumnadrochit	2·36
"	Wells, Westbury	4·06	XIX.	Lairg H.R.S.	3·52
VI.	Bristol, Clifton	3·02	"	Scourie	3·68
"	Ross	...	"	Watten H.R.S.	2·42
"	Wem, Clive Vicarage ...	1·56	XX.	Dunmanway, Coolkelure	6·42
"	Cheadle, The Heath Ho.	3·07	"	Fermoy, Gas Works ...	2·57
"	Worcester, Diglis Lock	2·23	"	Tipperary, Henry Street	...
"	Coventry, Coundon	2·16	"	Limerick, Kilcornan ...	2·49
VII.	Ketton Hall [Stamford]	1·85	"	Miltonwn Malbay	4·74
"	Grantham, Stainby	1·83	XXI.	Gorey, Courtown House	2·73
"	Horncastle, Bucknall ...	2·41	"	Navan, Balrath	3·14
"	Mansfield	...	"	Mullingar, Belvedere ...	3·04
VIII.	Neston, Hinderton	3·63	"	Athlone, Twyford	2·86
"	Knutsford, Heathside ...	3·13	"	Longford, Currygrane...	3·24
"	Lancaster, South Road.	3·33	XXII.	Galway, Queen's Coll..	3·79
"	Broughton-in-Furness ..	6·38	"	Clifden, Kylemore	10·50
IX.	Wakefield Prison	2·55	"	Crossmolina, Enniscoe..	3·76
"	Ripon, Mickley	2·39	"	Collooney, Markree Obs.	2·97
"	Scarborough, West Bank	2·19	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	3·39	XXIII.	Warrenpoint	3·17
"	Middleton, Mickleton ..	2·89	"	Seaforde	2·62
X.	Haltwhistle, Unthank..	4·27	"	Belfast, New Barnsley .	4·02
"	Shap, Copy Hill	3·06	"	Bushmills, Dundarave...	3·49
XI.	Llanfrechfa Grange	2·25	"	Stewartstown	3·67
"	Llandovery	4·12	"	Buncrana	2·82

JUNE, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				No. of High days.	No. of Low days.
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Deg.		Date	Deg.	Date			
				Dpth.	Date.								
I.	ENGLAND.	London (Camden Square) ...	2.82	+	.81	.53	28	17	78.2	25	40.8	1	0
II.		Maidstone (Hunton Court)...	1.75	+	.13	.35	10a	14	...	...	...	...	...
III.		Strathfield Turgiss	2.76	+	.96	.71	28	18	77.2	25	32.8	1	0
IV.		Hitchin	1.98	+	.07	.52	30	18	73.0	24b	47.0	30	0
V.		Winslow (Addington)	1.90	+	.04	.34	25	20	76.0	24b	33.0	1	0
VI.		Bury St. Edmunds (Westley)	2.30	+	.51	.50	10	18	...	...	...	...	...
VII.		Norwich (Cossey)	3.09	+	1.54	.50	12	18	...	...	...	...	...
VIII.		Weymouth (Langton Herring)	2.51	+	.28	.39	29	18	72.0	18c	43.0	1.7	0
IX.		Barnstaple	3.24	+	1.08	.50	25	17	69.0	14	37.0	1	0
X.		Bodmin (Fore Street)	3.98	+	1.23	.59	25	21	...	...	...	...	...
XI.	WALES.	Stroud (Upfield)	2.83	+	.44	.65	25	17	78.0	24	47.0	7	0
XII.		Churchstretton (Woolstaston)	1.57	+	.98	.52	10	17	71.0	23d	41.5	7	0
XIII.		Tenbury (Orleton)	1.93	+	.68	.54	29	11	77.0	24	33.1	1	0
XIV.		Leicester (Barkby)	1.79	+	.56	.35	28	14	79.0	15	38.0	14	0
XV.		Boston	1.40	+	.49	.35	28	13	77.0	12	36.0	1	0
XVI.		Hesley Hall [Tickhill]	1.72	+	.20	.50	30	14	74.0	9, 10	37.0	8	0
XVII.		Manchester (Plymouth Grove)	3.47	+	.82	.55	30	17	74.0	10	40.0	6.7	0
XVIII.		Wetherby (Ribeton Hall) ...	1.82	+	.07	.84	11	8	...	...	...	...	...
XIX.		Skipton (Arncliffe)	6.47	+	3.11	1.49	10	26	73.0	23	35.0	7	0
XX.		Hull (People's Park)	3.53	+	1.78	2.10	30	15	...	...	...	...	...
XXI.	SCOTLAND.	North Shields	3.16	+	1.61	.76	11	16	73.0	15	39.0	1.15	0
XXII.		Borrowdale (Seathwaite)	13.59	+	7.01	3.49	2	25	...	...	...	...	...
XXIII.		Cardiff (Ely)	2.97	+	.54	.50	25f	17	...	...	...	...	...
XXIV.		Haverfordwest	3.33	+	.77	.71	8	21	68.5	25	36.2	6	0
XXV.		Plinlimmon (Cwmsymlog) ...	7.63	+	...	1.11	22	22	...	...	...	...	...
XXVI.		Llandudno	2.54	+	.77	.35	25	18	67.0	23	42.3	8	0
XXVII.		Cargen [Dumfries]	3.96	+	2.01	.65	10	22	67.4	23	34.6	8	0
XXVIII.		Jedburgh (Sunnyside)	3.01	+	1.27	.75	11	16	68.0	23	36.0	8	0
XXIX.		Old Cumnock	3.79	+	1.93	.51	5	18	71.0	10c	30.0	6	2
XXX.		Lochgilphead (Kilmory)	5.33	+	2.23	1.04	2	23	...	...	...	...	...
XXXI.	IRELAND.	Oban (Craigvarren)	5.82	+	...	.99	3	23	64.8	13	39.6	8	0
XXXII.		Mull (Quinish)	6.64	+	3.35	1.11	3	22	...	...	...	...	...
XXXIII.		Loch Leven Sluices	3.40	+	1.65	.70	6	16	...	...	...	...	...
XXXIV.		Dundee (Eastern Necropolis)	2.90	+	1.40	.55	5	15	71.8	23	38.9	7	0
XXXV.		Braemar	2.63	+	.64	.55	3	17	65.8	15	33.2	14	0
XXXVI.		Aberdeen (Cranford) ...	1.85	+	...	.21	3	22	72.0	23	36.0	7	0
XXXVII.		Strome Ferry	5.60	+	2.54	.72	24	24	67.0	10	...	...	...
XXXVIII.		Culloden	1.91	+	.95	...	...	...	69.0	10	38.0	7	0
XXXIX.		Dunrobin	3.09	+	1.07	.64	3	16	64.0	21	37.0	8	0
XL.		S. Ronaldsay (Roeberry)	...	+	...	...	...	...	...	...	...	...	...
XLI.	Cork (Blackrock)	3.22	+	.88	.82	7	16	80.0	23	46.0	7.23	0	
XLII.	Dromore Castle	6.35	+	3.19	1.25	7	20	72.0	12	35.0	18	0	
XLIII.	Waterford (Brook Lodge) ...	3.76	+	1.69	.92	7	19	71.0	23	39.0	1	0	
XLIV.	O'Briensbridge (Ross)	3.45	+	...	.56	7	22	74.0	26	48.0	6	0	
XLV.	Carlow (Browne's Hill)	2.21	+	.37	.34	7	20	...	...	...	...	...	
XLVI.	Dublin (Fitz William Square)	1.93	+	.27	.36	11	18	72.0	5	43.2	7	0	
XLVII.	Ballinasloe	2.51	+	.21	.53	7	23	70.0	15	41.0	7	0	
XLVIII.	Waringstown	3.21	+	1.14	.51	29	20	76.0	15	41.0	23	0	
XLIX.	Londonderry (Creggan Res.) ..	3.38	+	.96	.35	5	25	...	...	...	...	...	
L.	Omagh (Edenfel)	3.23	+	.76	.36	5	25	68.0	15	44.0	23	0	

a And 30. b And 25. c And 23. d And 24. e And 15, 26. f And 29.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON JUNE, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—June opened with most favorable agricultural prospects. The winter was dry and equable, the spring forward, with just enough frost to mellow the land, and with sufficient rain to make all crops luxuriant. The showers in the middle of the month were very welcome, but the last fortnight, although satisfactory for the corn crops, was somewhat unfortunate for hay-making. T on 9th, 10th and 11th. Elder in flower on 7th; pink convolvulus on 19th. Meadow brown butterfly flying on 20th.

ADDINGTON.—Potatoes and kidney beans in low situations were cut down, and the foliage in some trees was blackened by frost on 1st. Frequent showers, but not much R until nearly the end, when there was also T.

BURY ST. EDMUNDS.—The month was cool, the hottest day being the 10th, with a max. of 71° in the shade. The early wheat had a very favourable time for blossoming. Very little T.

LANGTON HERRING.—Cold and wet, but there is still a little deficit in the R for the first six months of the year. Mean temp. a little below the average of 18 years. T on 12th and 13th. Much hay spoilt or injured.

BODMIN, FORT STREET.—A very wet and cold month; very few days of regular June weather. Thick mist on 22nd and 23rd.

WOOLSTASTON.—A showery, unsettled month, very unfavourable for the hay harvest. Mean temp. 56°·9.

LEICESTER, BARKBY.—L and T on 11th, 12th and 28th; T on 10th, H on 11th. (The return of 29°·0 as the minimum on May 27th, was queried by the Editor, but there was no question of its accuracy; beans, potatoes, marrows, fruit and flower blossoms were turned quite brown, and many plants killed). [We are glad that our suspicion of Mr. Pochin's thermometer was unfounded. It is a curious example of local frost. Ed.]

MANCHESTER, PLYMOUTH GROVE.—Summer weather on four days, viz., 20th, 21st, 22nd and 24th. The rest of the month very changeable and unsettled. T and L on 10th and 11th. Mean temp. 58°·0.

HULL.—The weather during the month was often cloudy, sometimes overcast and rather showery,. T heard on 27th. TS on 28th.

WALES.

HAVEFORDWEST.—A month of constant R and low temp.; and the amount of bright sunshine very small. Unmeasurable moisture fell on five out of the nine days on which no R was recorded, so that there were 26 days out of the 30 not dry. Scarcely any hay was cut during the month, an almost unprecedented occurrence, very unfortunate as the crop was abundant. The temp. never reached 70°, and on many nights the temp. was very low for the time of the year. The weather never recovered after the great TS of May 25th, when, as no rain gauge was to be found in the locality, the storm can only be judged by the damage done. Fields were flooded, 100 yards of road at Abermawr washed away, a huge mass of stone estimated to weigh a ton displaced and washed away, at the adjoining village of Mathry. Roads deeply cut like mountain ravines, and the telegraph wires attached to the cable crossing to Ireland were fused by the lightning.

SCOTLAND.

CARGEN.—Very dull weather prevailed during the month. Duration of sunshine 156 hours; 80 hours below the average. Mean temp. 54°·6, 2° below the average. There were only eight days during the month on which rain did not fall. T on the 10th, 27th and 28th.

JEDBURGH.—E was frequent during the month, and there was much sunshine, but occasional low temperature. Crops all looked well, and growth was vigorous. T and L on 27th.

OBAN.—Wettest June for 8 years; growth of crops abundant, but heat deficient. On 24th and 25th the centre of a cyclone of unusual violence passed here.

CULLODEN.—The temp. was below the average; grass abundant, and other crops well advanced.

IRELAND.

CORK.—Changeable weather throughout. Very warm on the 23rd. R .62 in. above the average of 25 years. Mean temp. $59^{\circ}\cdot 1$, being $1^{\circ}\cdot 4$ below the average of 14 years.

WATERFORD, BROOK LODGE.—T on 11th and 28th; fog on 13th, 14th, and 15th. H on 28th.

ROSS, O'BRIENSBRIDGE.—Showers frequent, but no large amount at any time. Day temp. below, but night temp. equal to, the average. Weather adverse to hay-making, but good for green crops. No T or L.

DUBLIN.—A cloudy, showery, windy month, of average temp. and pressure and showing a marked preponderance of S.W. and W. winds. Mean temp. $58^{\circ}\cdot 1$, slightly above the average. High winds on 15 days, but gales on only two occasions (3rd and 24th). The temp. reached or exceeded 70° in the screen on only two days, as compared with 17 days in 1887, 1 day in 1888, and 10 days in 1889. T on 11th and 28th. H on 28th and 30th.

BALLINASLOE.—A cold, wet, and windy month.

OMAGH, EDENFEL.—No other June since 1879 has been so persistently showery and unsettled. The temp. and bar. readings also bore a suspicious resemblance to that disastrous year. No damage had, however, resulted at the close, and nothing but finer weather is required to secure a year's produce of unexampled abundance.

THE RAINFALL OF JULY 4TH-5TH, 1890.

To the Editor of the Meteorological Magazine.

SIR,—The extraordinary rain of last week here deserves to be recorded in your Magazine. In the 24 hours between 5.30 p.m. of Friday, the 4th inst., and 5.30 of Saturday the 5th, there fell 3.30 in., and of this quantity 1.67 in. fell between 7.5 and 9.30 on Saturday morning. These falls are quite unprecedented during the 16 years of my observations in Ramsgate. The eight days of this month already elapsed have given more rain than any entire month of July during those years except that of 1888.—Yours faithfully,

M. JACKSON.

The Vale, Ramsgate, July 9th, 1890.

[We have also received notes whence we add the following extracts—*Ed. M. M.*]

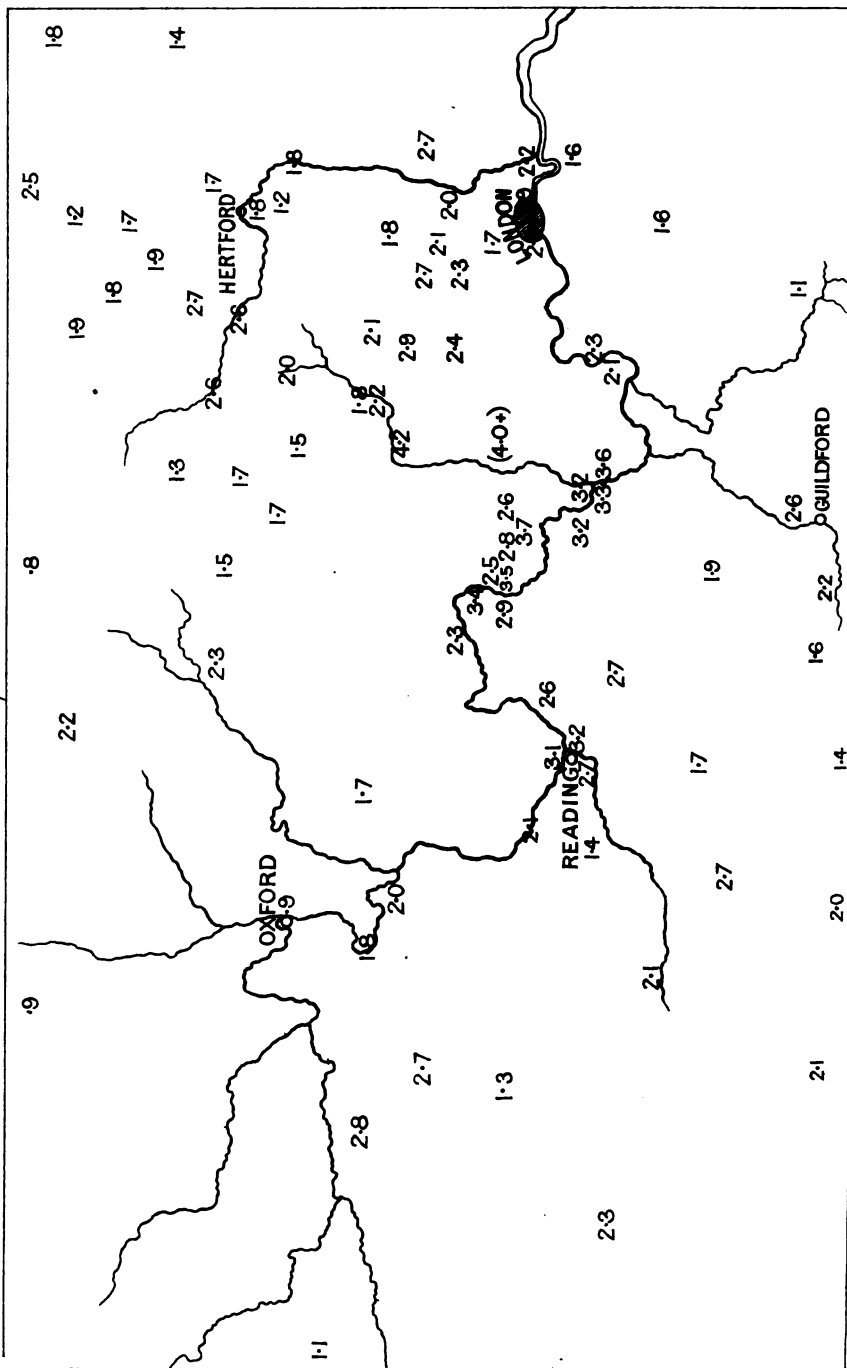
Lower Cowsley Wood, Wadhurst, Sussex.—3 p.m. on 4th to 9 a.m. on 5th, 1.26; 9 a.m. to 4 p.m. on 5th, .44; total, 1.70 in.—F. WILKIN.

Hartley, Cranbrook, Kent.—9 a.m. 4th to 9 a.m. 5th, 1.04; 9 a.m. 5th to 9 a.m. 6th, .50; total, 1.54 in.—G. PILE.

Tenterden, Kent.—3 p.m. on 4th to 9 a.m. 5th, 1.09; 9 a.m. 5th to 1.20 p.m., .11; total, 1.20 in.—J. E. MACE.

Capel Lodge, Folkestone, Kent.—3.30 p.m. 4th to 9 a.m. 5th, 2.58; 9 a.m. to 9 p.m. 5th, .32; total, 2.90 in.—E. NORTON, M.D.

DEPTH OF RAIN, JULY 17TH 1890.



London Standard's Geog. Estab.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCV.]

AUGUST, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE GREAT RAIN OF JULY 17TH, 1890.

WE do not call this the St. Swithin's rain of 1890, because we wish the tradition as to the 40 consecutive days of rain to die out; but the latter half of July is not an infrequent date for a great rainfall. Cases similar to the recent fall were that of July 26th, 1867 (which we worked up fully and described in vol. ii. (1867) of this magazine, p. 75), and that of July 14th, 1875, specially treated in *British Rainfall*, 1875, and in a paper on the floods of 1875, printed in the *Proc. Inst. C.E.*

The rain of 1867 extended into two days. At two stations near Sittingbourne and Chatham the total reached 5 inches, and at seven stations it reached or exceeded 3 inches in the two days.

The rain of 1875 also extended into two days, but it was heaviest in Monmouthshire and the S.W. of England; there, at some stations, the total fall exceeded 5 inches.

The rain of 1890 fell chiefly on one day (the 17th), and though about half an inch more fell on the 18th, it was separated by a dry period, and therefore, in the following notes and in the accompanying map, we deal with the fall of the one day (the 17th) only.

We have been favoured by many of our correspondents with notes on the fall. We shall quote here those daily totals only which exceed three inches. Others are given on the map, and the whole facts will have to be thoroughly discussed in *British Rainfall*, 1890.

The largest records which we have yet received are—

4·19 in.	at Moor Park, Rickmansworth, Herts.
3·68	„ Langley, Slough, Bucks.
3·60	„ Belle Vue, Staines, Middlesex.
3·45	„ Taplow Court, Maidenhead, Berks.
3·37	„ Cookham Vicarage, Maidenhead, Berks.
3·33	„ Cooper's Hill [Staines], Surrey.
3·24	„ Portland Place, Reading, Berks.
3·20	„ Knowle Green, Staines, Middlesex.
3·10	„ East Thorpe, Reading, Berks.

The following gauges ran over. As regards these stations, therefore, our knowledge is limited to the fact that the rain was greater than

4·00 in.	at Hillingdon, Uxbridge.
2·08	„ Gorhambury, St. Albans.
2·00	„ Greenlands, Henley-on-Thames.
1·94	„ Pinner Hill.

PHENOLOGICAL OBSERVATIONS.

(Translated from "*Ciel et Terre*").

The utility of these observations as an auxiliary to the study of climates has long been recognized.

In five years a phenological observer may have obtained mean dates sufficiently accurate to enable him to judge of the successive advent of the various phases of vegetation. If one has ascertained the mean date for five years of the principal phenomena, *e.g.*, when in the immediate neighbourhood of the observer the first blooms of the blackthorn open, or the first fields of barley are cut, one is in a position to decide; (1) How the station is related to one of which the averages have already been long determined; (2) How various localities are related to the principal station, whether they are colder or hotter, as indicated by the relative maturity of plants in the two localities; one obtains these results much better than if one had established and compared hundreds of thermometers and rain gauges in a hundred different positions, putting aside the impossibility of observing them all, and the difficulty of procuring and erecting them; phenological observations cost nothing, while meteorological instruments are expensive; (3) Each year, and each week of the year, one can compare the observations of the progress of vegetation with the means, and ascertain whether at one's own station the season is early, normal or late. Phenology is a species of thermometry which may even occasionally correct erroneous conclusions from thermometric records. Thus Hoffmann has remarked that it is a peculiarity of oak brushwood to leaf much later than full grown trees of the species, although, if considered from the thermometric stand-point only, one would be inclined to attribute it to the dampness and consequent coldness of the positions occupied by the brushwood. A plant is, in fact, a sort of registering thermometer, which like the thermometer shows us present temperature, but in addition the final effect of past temperatures, a result we can arrive at only imperfectly by summing up the daily mean temperatures. Phenological observations, with figures founded on comparisons, have the advantage of presenting to the mind facts easily grasped. As regards biological problems, isotherms are not necessary, because they do not give the real average temperature. That is why isotherms cannot coincide with isophanes (lines of equal phases of vegetation). Accurate observations of the phases of vegetation, and the determination of their mean value, furnish important indications as to the further progress of the plant, by the differences which they present from the normal value. But it has another result. By comparing during a year the flowering of certain plants in different places in a district, we may be able to determine the amount of heat received in each of these positions in a given time. These phenological observations enable us to examine predictions which have come down to us from remote ages, such as the speedy

arrival of winter, after the fall of the bloom of the heath, and the larch losing its leaves. Hoffmann has observed that out of 29 years, in 21 the early or late opening of the buds of the chestnut has corresponded with a following winter warm or cold. In fact, phenology may attain the same precision as meteorology, for the two modes of observation can each give only approximate values.

BALL LIGHTNING.

Dr. E. Cabellero, who is professor of physics and director of the Electrical Works at Pontevedra, has sent to the observatory at Madrid, the following account of phenomena seen by himself :—

On January 2nd (1890 ?) at 9.15 p.m., the sky being cloudless and the weather calm, a ball of fire about the size of an orange, suddenly entered the works. This ball of fire entered by a window or light, after having probably come along one of the conductors for the electric light. [Very respectfully, we think it more likely that it came along the conductors the whole distance, and not through the window ; open windows at 9.15 p.m. in January, in Madrid, scarcely seem probable, and Dr. Cabellero evidently did not see it enter, or he would not say, “par une fenêtre ou une lucarne.”—*Ed. Met. Mag.*]

From the window it went to the switch-board and thence to the dynamo. Twice in the sight of the frightened engineers and workmen, it darted from the switch-board to the dynamo, and from the dynamo to the switch-board, and finally fell on the ground and burst into fragments, leaving, however, no traces except by fusing some of the thick copper conductors on the switch-board. A noise like the discharge of a cannon accompanied its dissipation. The street lamps were extinguished for a few seconds, but as the dynamo was not injured the current was speedily restored.—*Ciel et Terre.*

NEW METEOROLOGICAL STATION AT POMPEI.

Although unable to accept the invitation to be present at the inauguration of the above, we are glad to devote a few lines to record that which brings, so strangely, ancient and modern times together. We are indebted to Avv. Bartolo Longo for several papers,* whence we gather that considerable ecclesiastical and charitable buildings are rising on a site near to, or actually over, Pompei. That the organizers of this new Pompei attach considerable importance to intimate relations existing between Religion and Science ; and, as one step in that direction, they have provided all the apparatus required for a second order station, with the addition of seismometers and photographic apparatus for recording the smoke from

* *Le Armonie della Religione e della Civiltà nella Nuova Pompei. Programma delle Feste di Maggio, 1890, and others.*

Vesuvius, and have established what with some grandiloquence they term the "Osservatorio Meteorico-Geodinamico-Vulcanologico." The inauguration took place on May 15th, 1890, when many leading Italian observers were present, addresses being delivered by Padre Denza, Prof. Stefano de Rossi and others.

CAUSE OF ATMOSPHERIC DEPRESSION.

To the Editor of the Meteorological Magazine.

SIR,—In the number of this magazine for June, 1890, p. 75, occurs the following sentence, by the Rev. Clement Ley, in a letter on this subject:—"Now, after full attention has been devoted to the works of Faye, Hazen, and other oppositionists, the fact remains that the character of the current of scientific theory on this subject is strong enough to be, to most of us, unmistakable." A little later, reference is made to the work of Prof. Ferrel as being fundamental and conclusive. It is probable that meteorologists in England, and on the Continent, are not fully aware of the true inwardness (*sic*) of scientific theories in meteorology in America, nor of the extreme contradictions between such theories and the facts. Your correspondent should have stated that Prof. Ferrel is second in this field so well studied by Espy half-a-century ago. Here are Prof. Ferrel's own words. He says, in describing the force needed to maintain a storm, "This force may be furnished by the condensation of vapour ascending in the upward current in the middle of the hurricane, in accordance with Prof. Espy's theory of storms and rains." This is sufficient to show that, after all, we must go back, not to Ferrel, but to Espy. If it can be shown that Espy was entirely misled by his experimental researches, that the proofs which he thought he had were entirely incorrect, and more than all, that a careful repetition of his experiments shows that absolutely no energy can be obtained in the maintenance of storms by the liberation of latent heat from condensing moisture, and a consequent increase in the rarefaction at the centre, as he thought, then a death-blow has been struck to all theories founded upon his researches. I think it may be fairly admitted that Espy's work has been shown to be exceedingly faulty, and it may be hoped that meteorologists ere long will be enabled to cast off this millstone which has so long been dragging them down, and, by a series of careful experiments, make a fair start toward building up a science. It is an astonishing fact that students of meteorology are the only ones who have been content with vague speculations, and have not founded their science upon a firm and substantial groundwork of fact.

It is probable that nothing could emphasize the necessities of the case better than the recent most extraordinary statements of Dr. Hann, of Vienna. He has made a study of the temperature conditions at high and low stations during the passage of storms and high pressure areas, and has come to the conclusion that above the earth's surface the temperature in our storms is markedly *diminished*, while in our

high pressure areas it is *increased*. The utter lack of faith in present theories of storm formation could hardly be better shown than by the extraordinary rapidity with which they were brushed aside by meteorologists to accept this new dictum by an *authority*.* It is true that Dr. Hann has been woefully misled by his researches, and that the temperature is certainly higher in the centre of our storms up to 14,134 ft., the height of Pike's Peak, than it is before or after the centre has passed. The surprising thing is, that no one questions the results of another, nor has faith enough in his own views to maintain them until forced to yield inch by inch.

One other point I will mention. It is hardly true that the arguments of the oppositionists have had full attention paid to them. These arguments have either been ignored as unworthy of attention, or, where an attempt has been made to answer them, the results showed how utterly weak the ordinary theories were. It is a remarkable fact that every theory of storm formation, from its beginning by an abnormal heating at the earth's surface to its maintenance by rarefactions in the upper air, due to a peculiar distribution of temperature with height, has had no fact as a basis. The present theories in meteorology can be likened to nothing better than "the baseless fabric of a vision."

H. A. HAZEN.

Washington, July 1, 1890.

SOLAR RADIATION THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—You have kindly sent me some back numbers of the *Meteorological Magazine* containing articles and letters on solar radiation instruments, and consequently it was only last week that I saw the letter of Mr. H. Sowerby Wallis in the number for January of this year, and it must have appeared discourteous of me not to have replied to it before.

The cases of the thermometers described in my paper to the British Association had an external diameter of 63 millimetres. The large thermometer bulb had a diameter of 11.1 mm.; it was made of white glass, and was coated with lamp black. The small bulbs were 5.6 mm. in diameter, and were made of black glass, which had, however, a smooth surface, and therefore reflected some light and heat.

The instruments have, unfortunately, been broken, but this has given me the opportunity of measuring the thickness of the cases. That which enclosed the thermometer with the large bulb had a knob of glass on it, produced by closing the bulb after the thermometer had been introduced. Two pieces of glass near the equator of the bulb were measured, and were found to have a thickness of .52 mm.

The cases of the two small thermometers were made as nearly

* We do not follow this argument; Prof. Hazen evidently accepts Dr. Hann as an "authority," yet condemns meteorologists for doing the same thing.

uniform in thickness as possible, the thermometers having been introduced from the other ends of the tubes. The thin case had a thickness of .59 mm, and the thick case was no less than 5 mm. in thickness, much stouter than I intended it to have been.

On looking through the back numbers, I find that the theory propounded in my paper last year was published nearly 20 years ago; for on September 26th, 1870, Mr. Henry R. Procter wrote to you a letter printed in the number for December, 1870 (*Met. Mag.* v. 183), which contains all I wrote on the subject. I need hardly say that I had no idea that I had been anticipated so completely, and no one has ever directed my attention to this letter.

In view of this theory it appeared possible that the blackening of the stem of the thermometer, as well as of the bulb, might have some influence on the readings, for additional heat would be absorbed by the blackened stem which would, by radiation, raise the temperature of the case, so it seemed of importance to diminish the length of the blackened portion of the stem.

Mr. Stow's letter of July 18, 1868 (*Met. Mag.* iii. 115), shows so clearly the necessity of blackening the stem to prevent conduction removing heat from the thermometer bulb that it seems hopeless to dispense with it; however, it appeared worth while to try some experiments on the conduction of heat along a stem. For this purpose a thermometer was placed horizontally, and a piece of filter paper was tied round the stem a quarter of an inch from the bulb, and a screen of card, with a hole in it, was fixed between the bulb and the paper. Ether was dropped on the filter paper, and at first no effect was observed. After a minute and a quarter the mercury began to fall, and in four minutes the temperature had fallen 5°, moisture being deposited on the stem, between the bulb and the filter paper. With another thermometer the temperature began to fall in 50 seconds, and at the expiration of 4½ minutes the temperature was lowered 8.1°. The object of the screen was to prevent the cold vapour of the ether from coming in contact with the bulb, which would, of course, lower the reading.

In another experiment with the first thermometer the filter paper was placed one inch from the bulb. The paper was kept wetted with ether for 8 minutes, and the temperature fell only 0°.4. Moisture was deposited on the tube, and extended about half an inch from the paper. Probably some of this apparent fall of temperature was due to the cooling of the thread of mercury, as a considerable length of the tube was cooled. On placing filter paper on the bulbs of the thermometers and wetting it with ether, the temperature was lowered about 53°, which is probably not far from the difference of temperature between the bulb and stem of a black bulb thermometer in vacuo when the sun is shining on it. So conduction may seriously affect the readings of such an instrument, if a sufficient length of the stem is not blackened.

I still think that the blackening of the stem should be diminished

as much as possible, and perhaps another way to check the conduction would be to lessen the cross section of the stem close to the bulb, by making a narrow neck between the bulb and the tube. If the bulb and neck only were blackened, it would materially diminish the quantity of heat radiated to the inside of the case.

Faithfully yours,

HERBERT MCLEOD.

Cooper's Hill, August 7th, 1890.

THE COLD WEATHER OF MARCH.

To the Editor of the Meteorological Magazine.

SIR,—Though I am very late in making this communication, yet I think that it may still interest some of your readers to know that the above cold spell reached even Madeira, and that the lowest temperature ever observed in Funchal was recorded on March 6th, 1890. I then registered in a Stevenson's screen a minimum of 43° F, and though my instruments are placed at an altitude of about 350 ft. above the sea, identically the same temperature was recorded at the Government Observatory in the town. The lowest temperature previously recorded was 45°·7 on March 11th, 1883, but this year on four consecutive nights I registered a minimum lower than that, viz.—

March 5th, 45°·0 F.

„ 6th, 43 °0

March 7th, 44°·0 F.

„ 8th, 44 °2

At 7 a.m. on the 7th, there was a single clap of thunder, followed by a sharp hailstorm, which quite whitened the ground, and remained for a quarter of an hour or so before melting. It caused a good deal of interest, for our native Madeira servants and others around had never previously seen any snow or hail fall, though, of course, snow falls frequently enough on the higher mountains of the island.

I am, yours truly,

H. COUPLAND TAYLOR, M.D., F.R.MET.SOC.

Madeira.

REVIEWS.

Wanderings in Search of Health, or Medical and Meteorological Notes on various Foreign Health Resorts. By H. COUPLAND TAYLOR, M.D., F.R.Met.Soc. London: Lewis, 1890. 8vo, cloth, 259 pages, 5 plates.

DR. COUPLAND TAYLOR was for some time one of our rainfall observers, but ill-health compelled him to leave the wet locality in which he had been practising, and for the last four years he has been, as the title of his book says, "Wandering in search of Health." We are glad to know that not only has he found it, but in the work before us he has recorded his views as to the *pros* and *cons* of most of the places usually visited.

It is not for us to discuss medical questions, but there is one idea which frequently recurs in this book which has startled us, and set us thinking and making some enquiries. Evidently consulting physicians (whom, by the bye, he somewhat drolly calls "consultants"), do not stand high in Dr. Coupland Taylor's opinion, and he, both on his own account and by quotations from other medical men, implies (and illustrates by examples) carelessness and want of knowledge and of judgment in the advice they give as to the localities to which phthisical patients should go. It is difficult to believe that a sweeping charge like that can be substantiated. We know that it is not true of some consulting physicians, because we could name one who is not merely wearing himself out by the thought which he bestows on each individual case, but who stops at neither distance nor expense in order, by personal inspection at various seasons, to make himself familiar with each new health resort as it comes into notice; but, on the other hand, we have just applied what seems a reasonable test with a very unsatisfactory result.

An expert on any subject should surely be well acquainted with the literature upon it. A doctor who professes to advise as to climate might be supposed to take sufficient interest in the subject to seek election into the Royal Meteorological Society, in order (even if he had not time to attend the meetings) that he might see the quarterly journal and keep himself *au courant* with the published data as to climate. We have been through the last list of Fellows, and can find only seven London medical men—and of those we believe that there is only one—who is an expert in consumptive cases. Surely there is more than one London physician who advises on climatic matters. It does look therefore as if Dr. Coupland Taylor's criticisms have some foundation.

The special characteristics of the book seem to us to be fairness and common-sense. Dr. Coupland Taylor comes down alike on the profession and on the patients. We give a specimen of each:—*Place aux Dames*: Dr. Taylor is writing of the dances at Davos—

"It is impossible to keep some ladies away from this amusement, for if there is a dance taking place in any of the hotels, they will dance all the evening, in spite of the doctor's strictest orders to the contrary, and suffer for days after in consequence."

Now for the doctors.

"At the present day but little seems known of the climate of Madeira among the medical profession at large. When a London specialist, on this subject, describes the climate to be like the atmosphere of the 'hot and well-steamed room of a patient suffering from bronchitis,' one can see how little its real climate is known and appreciated."

"Again, Prof. Charteris, in his work on 'Health Resorts,' makes the astonishing statement: 'During the season of 1881-82 there was at Davos a clear, unclouded sky from the beginning of November to the end of March.

Unfortunately I cannot obtain the statistics of the weather for that year, but the correctness—[incorrectness—Ed. *M.M.*—] of the statement may be gathered from the fact that in the exceptionally fine season of 1879–80, ‘perhaps one of the most perfect ever known in the Alps’ (Yeo), rain or snow fell on 36 days between November and March.”

The author, being himself a skilled observer and F.R.Met.Soc., the meteorological data in this book are exceptionally trustworthy; but we find one new term as to the adoption of which there may be some doubt. Dr. Taylor seems to take it for granted as if already accepted, but we never met with it before. “The absolute humidity, however, is the absolute quantity of aqueous vapour which is suspended in a given volume of air.” “Absolute humidity” is of course much shorter than “Grains of vapour in a cubic foot of air,” but it is liable to be confused with “Relative humidity,” and there is the further question whether the term is legitimate.

The places chiefly dealt with are the Ocean, the Engadine, Davos, Madeira, Canary Isles, and Western Riviera. On each and all Dr. Taylor gives much valuable information, so that there are few practitioners or patients who would not profit by reading his book.

There is in it a large amount of useful meteorological information, and while not suggesting that it should be taken from where it is, we think that two or three pages devoted to a tabular summary of the figures scattered through the book would be a handy addition. It is well printed, and the plates are excellent specimens of some process of photographic reproduction.

Congrès International d'Hydrologie et de Climatologie.—Compte Rendu de la Deuxième Session, Paris, 1889. Doin: Paris, 1890. 8vo., 504 pages.

At the first Congress at Biarritz, it was resolved that by exception the next should be held in Paris during the Exhibition. There had been too many Congresses, and coming as the Hydrological one did nearly the last, and in cold rainy weather it suffered seriously and afforded a painful contrast to the bright, enthusiastic and well attended one at Biarritz. It remains to be seen by the gathering at Rome in 1893, whether the Congress supplies a real need or not.

The volume before us is a handsome and substantial one. The first 250 pages are wholly medical. On some of the papers in the latter half we intend to offer a few notes.

On the precautions requisite in observing accurately the temperature of thermal springs, by M. Renou. The author called attention to the fact that mercurial thermometers rise with age, and to the possibility of avoiding this error by applying Denton's process before graduating them. He also urged that thermometers be sent to the Bureau Central or to the observatory at Parc St. Maur for verification. He expressed his belief that the majority of clinical thermometers read

too high, and that the real temperature of the human blood is $98^{\circ}33$, which is his normal state. [On looking at our pocket Immisch thermometer, the red arrow for blood heat points to $98^{\circ}2$, so, apparently Frenchmen and Englishmen do not differ much. Ed. *Met. Mag.*] M. Renou considered that the most accurate mode of taking the temperature of a thermal spring is to place a thermometer in a bottle, sink the whole to the bottom, and after a suitable time to draw all up together. M. Youji-Wada, of Tokio, said that in Japan there was an intimate relation between the temperature of springs and the occurrence of squalls. Dr. Fines called attention to the influence of rain on the temperature and mineralization of some thermal sources. Mr. Symons explained the precautions which he had taken in determining the temperature of Pyrenean springs, and also urged that the verification of thermometers should be put in France as in England, on a commercial footing, so that verified thermometers should be the rule rather than the exception.

There is a very puzzling fact shewn by the reproduced traces of a Richard thermograph, in a paper by Dr. Lalesque, on the climate of Arcachon. Dr. Lalesque notices the fact, but offers no explanation. He gives the curves for 26 days, and on 14 of them the usual fall of temperature from sunset to sunrise is stopped or replaced by a rise between 9 p.m. and midnight. The author states that he has a Montsouris thermometer stand, and speaks much of the verification of his instruments. We can hardly doubt that the thermograph was on this stand, but if so, and suitably distant from buildings, the rise in question is a perfect mystery.

Dr. Gandy in a paper on the Climatology of the S.W. of France, tells us that as the result of the discussions at the Biarritz meeting, M. Henri Léon, of Bayonne, has established a fortnightly *Bulletin de Climatologie*, which gives the records at several stations between Arcachon and Bagnères de Bigorre. We have not yet seen that periodical, and we think that either through the printing of some extra copies of it, or by the insertion of abstracts of the records in the *Annuaire* of the *Soc. Met. de France*, the results ought to be generally accessible.

M. Mendez Guerreiro of Villa Fernando, Portugal, stated that having been charged with the establishment of a reformatory school in a marshy district, where the daily range of the thermometer was sometimes 54° F., he had planted 100,000 eucalypti, dried the marsh, equalized the rivers and brought the extreme daily range down to 32° F.

One would much like the details of this remarkable case—including evidence that the climatic conditions over that part of Portugal were identical at the two times—*i.e.*, that the difference between 54° and 32° , was really wholly due to the planting.

The volume closes with a paper on a Programme of a course of Lectures on Climatology, by M. Georges Lemoine, concerning which

we need say only that it is worthy of the author and of the attention of all who intend to treat the subject either in a volume or in lectures. There are two points upon which we should be glad of enlightenment.—(1). What experience induces M. Lemoine to recommend the Piche evaporator? (2). Where is it possible to procure one of the books recommended for study, viz., *Cours de météorologie*, by M. Millot?

Weather Forecasting for the British Islands, by means of a barometer, the direction and force of the wind, and cirrus clouds. By CAPT. H. TOYNBEE, F.R.A.S., F.R.Met.Soc., late Marine Superintendent, Meteorological Office. London: Stanford, 1890. sm. 8vo., iv. 36 pages and 8 plates.

FROM the preface to this little book, we learn that after Captain Toynbee's retirement from the superintendence of the marine department of the meteorological office, the Meteorological Council requested him to go on tours round parts of our coasts, and give lectures to the seamen on storms and how to avoid them. We are not sure that the Council ever expended money more wisely. Captain Toynbee's life-long experience, his kindliness and his earnest desire to do good, would give him a hold upon his audiences such as few men could obtain, and when he had secured their attention, instead of frightening them, or sending them to sleep by abstruse technicalities, we have no doubt that many a bright story from his own experience would be brought in to fix the lessons he had to teach.

This little book seems to be one or more of the lectures written out for publication, and therefore, perhaps rather stiffer and less homely than as verbally delivered. But it is very unpretentious and practical, admirably suited for beginners, while those who know everything in it are not numerous enough seriously to affect its circulation.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JAN., 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.									
England, London	55·6	25	26·1	2	48·9	37·9	40·1	87	83·1	18·3	2·46	21	7·4
Malta.....	67·5	26	46·2	16	61·4	52·2	48·6	80	117·1	39·3	1·32	8	4·9
Cape of Good Hope ...	92·0	7	53·0	15a	77·7	59·6	...	...	...	...	·44	...	2·8
Mauritius.....	84·4	15	69·0	...	82·4	72·7	68·6	77	139·5	61·2	5·01	16	6·1
Calcutta.....	81·7	24	47·6	28	77·0	56·5	57·2	74	135·5	38·6	·77	1	8·2
Bombay.....	89·5	14	65·6	22b	84·7	68·6	63·4	65	135·9	50·5	·00	...	0·4
Ceylon, Colombo	91·4	10	66·0	25	86·9	71·1	67·2	71	151·0	58·0	·81	6	3·8
Melbourne.....	101·5	25	47·9	8	83·8	60·4	57·2	63	156·5	38·0	1·37	7	4·3
Adelaide.....	105·0	18	54·7	4	91·4	68·0	55·3	42	163·9	43·7	·62	10	3·1
Wellington	80·0	8	44·0	14	68·5	52·4	48·7	66	138·0	37·0	3·25	9	3·8
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston.....	90·9	2, 12	62·0	14	88·9	64·5	65·8	72	...	...	·34	...	...
Trinidad	87·0	var.	64·0	16	84·3	68·8	69·7	80	158·0	...	7·76	22	...
Toronto	53·9	6	6·4	11	36·9	22·3	25·7	83	...	4·0	3·36	21	8·1
New Brunswick, Fredericton	51·8	2	24·0	10	23·4	—	0·5	11·8	80	...	3·21	17	5·0
Manitoba, Winnipeg ...	26·4	28	39·4	17	2·9	22·3	9·0	98	...	...	·51	10	4·6
British Columbia, Victoria	47·0	27	12·0	15	37·5	27·3	...	...	...	...	3·96	15	...

a And 28.

b And 27.

REMARKS, JANUARY, 1890.

MALTA.—Mean temp. 56°·0; mean hourly velocity of wind 11·3 miles. Sea temp. fell from 61°·0 to 60°·0. TS with H on 13th. Pressure unusually steady, and temp. much above the average. J. SOULES.

Mauritius.—Mean temp. of air 1°·5, dew point 1°·2, and B 1·99 in., below their respective averages. Mean hourly velocity of wind 10·6 miles, or 0·6 below average; extremes, 25·3 on 20th, and 2·0 on 10th; prevailing direction, E.S.E. to E. by N. L on 15th, T and L on 17th and 18th, and T on 20th and 31st.—C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—L seen on the night of the 31st.

J. C. H. CLARKE, Lt. Col. R.E.

Melbourne.—Mean temp. of air 5°·3, and of dew point 4°·3 above, humidity °1, of cloud 0·9, and of B ·42 in., below their respective averages. Prevailing wind S., strong on 6th from S., and on 9th and 21st from N., and on 29th, 30th, and 31st from S.E. and E. TS on 3 days, L on 2 days. Weather sultry and oppressive almost throughout the month. R. L. J. ELLERY, F.R.S.

Adelaide.—A most disagreeable month. Mean pressure about the average, but the mean temp. 5°·1 above previous 33 years, and greatest on record since 1858. No very hot days, but excessively humid. C. TODD, F.R.S.

Wellington.—Fine early part of the month; heavy B on the night of the 7th, and continued showery for some days; fine during latter part of the month, and very warm at times. Prevailing N.W. wind, and occasionally strong; on the whole a fine month. R. B. GORE.

TRINIDAD.—The B for January is 5·15 in. above the 25 years' average.

J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL,
JULY, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	3.54	XI.	Castle Malgwyn	2.94
"	Margate, Birchington...	3.62	"	Builth (Llanwrtyd Wells)	4.92
"	Littlehampton	2.97	"	Rhayader, Nantgwillt..	2.79
"	Hailsham	3.07	"	Carno, Tybrith ...	2.40
"	Ryde, Thornbrough	3.78	"	Corwen, Rhug	2.64
"	Alton, Ashdell	3.31	"	I. of Man, Douglas	2.54
III.	Oxford, Magdalen Col...	2.96	XII.	Stoneykirk, Ardwell Ho.	2.84
"	Banbury, Bloxham	2.76	"	New Galloway, Glenlee	3.81
"	Northampton	2.96	"	Melrose, Abbey Gate...	2.82
"	Cambridge, Fulbourne..	4.87	XIII.	N. Esk Res. [Penicuik]	5.15
"	Wisbech, Bank House..	2.56	XIV.	Ballantrae, Glendrishaig	2.79
IV.	Southend	2.83	"	Glasgow, Queen's Park..	4.33
"	Harlow, Sheering ...	...	XV.	Islay, Gruinart School..	3.58
"	Rendlesham Hall	4.91	XVI.	Dollar	3.51
"	Diss	3.43	"	Balquhider, Stronvar..	5.15
"	Swaffham	4.11	"	Coupar Angus Station..	3.38
V.	Salisbury, Alderbury...	3.60	"	Dunkeld, Inver Braan..	3.83
"	Warminster	3.50	"	Dalnaspidal H.R.S. ...	4.68
"	Bishop's Cannings	3.44	XVII.	Keith H.R.S.	3.94
"	Ashburton, Holne Vic...	4.26	"	Forres H.R.S.	3.88
"	Hatherleigh, Winsford.	...	XVIII.	Fearn, Lower Pitkerrie.	...
"	Lymouth, Glenthorne.	2.87	"	Loch Shiel, Glenaladale	9.78
"	Probus, Lamellyn	3.75	"	N. Uist, Loch Maddy ...	4.93
"	Launceston, S. Petherwin	3.73	"	Invergarry	5.63
"	Wincanton, Stowell Rec.	3.32	"	Aviemore H.R.S.	3.32
"	Taunton, Lydeard Ho...	...	"	Loch Ness, Drumnadrochit	3.09
"	Wells, Westbury	4.46	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	3.41	"	Scourie	4.30
"	Ross	3.33	"	Watten H.R.S.	3.79
"	Wem, Clive Vicarage ...	3.20	XX.	Dunmanway, Coolkelure	5.09
"	Cheadle, The Heath Ho.	2.68	"	Fermoy, Gas Works ...	2.42
"	Worcester, Diglis Lock	1.91	"	Tipperary, Henry Street	2.10
"	Coventry, Coundon	2.21	"	Limerick, Kilcornan ...	2.30
VII.	Ketton Hall [Stamford]	2.65	"	Miltown Malbay	4.49
"	Grantham, Stainby	2.31	XXI.	Gorey, Courtown House	1.70
"	Horncastle, Bucknall ...	2.04	"	Navan, Balrath	2.02
"	Workshop (Hodsock Priory)	2.12	"	Mullingar, Belvedere ...	2.67
VIII.	Neston, Hinderton	2.10	"	Athlone, Twyford	2.69
"	Knutsford, Heathside ...	2.33	"	Longford, Currygrane...	2.95
"	Lancaster, South Road.	3.87	XXII.	Galway, Queen's Coll...	3.29
"	Broughton-in-Furness ..	5.29	"	Clifden, Kylemore	5.89
IX.	Wakefield Prison	1.89	"	Crossmolina, Enniscroe..	3.38
"	Ripon, Mickley	1.17	"	Collooney, Markree Obs.	3.77
"	Scarborough, West Bank	1.65	"	Ballinamore, Lawderdale	...
"	East Layton [Darlington]	2.70	XXIII.	Warrenpoint	3.02
"	Middleton, Middleton ..	1.87	"	Seaforde	2.35
X.	Haltwhistle, Unthank..	2.14	"	Belfast, New Barnsley..	2.59
"	Shap, Copy Hill	4.07	"	Bushmills, Dundarave...	...
XI.	Llanfrehfa Grange	3.32	"	Stewartstown	1.96
"	Llandovery	4.57	"	Buncrana	3.78

JULY, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Differ- ence from average. 1880-9	Greatest Fall in 24 hours.		Dpth.		Date.	Max.		Min.		
				inches.	in.				Deg.	Date	Deg.		Date
I.	London (Camden Square) ...	4.20	+ 1.52	1.67	17	14	76.2	23a	45.1	4	0	0	
II.	Maidstone (Hunton Court)...	3.53	+ 1.35	1.85	4	16	...	...	...	...	...	...	
III.	Strathfield Turgiss ...	3.44	+ 1.05	1.78	17	19	77.6	23	41.9	4	0	1	
III.	Hitchin ...	4.11	+ 1.39	1.88	17	19	73.0	23	44.0	11	0	...	
IV.	Winslow (Addington) ...	4.56	+ 1.27	2.20	17	21	76.0	13b	42.0	4f	0	...	
IV.	Bury St. Edmunds (Westley)	5.35	+ 2.78	2.70	17	17	...	...	...	...	...	...	
V.	Norwich (Cossey) ...	...	...	...	...	...	...	...	...	...	...	...	
V.	Weymouth (Langton Herring)	2.66	+ .51	.61	7	19	73.0	26	46.0	4, 6	0	...	
"	Barnstaple ...	2.73	-.74	.74	16	13	70.0	31	43.0	10g	0	...	
"	Bodmin (Fore Street) ...	5.07	+ .46	1.46	16	23	...	...	...	...	...	...	
VI.	Stroud (Upfield) ...	2.84	-.73	.72	17	17	79.0	23	45.0	6	0	...	
"	Churchstretton (Woolstaston)	2.10	-.87	.43	16	22	70.0	22	44.0	12	0	...	
"	Tenbury (Orleston) ...	2.50	-.36	.60	16	19	75.0	13b	38.0	4	0	0	
VII.	Leicester (Barkby) ...	2.50	-.49	.63	2	21	79.0	13	40.0	9, 11	0	...	
"	Boston ...	1.60	-.19	.33	18	16	81.0	17	41.0	6	0	...	
"	Hesley Hall [Tickhill]...	1.90	-.77	.35	18	16	75.0	16	43.0	12	0	...	
VIII.	Manchester (Plymouth Grove)	2.63	-.16	.39	25	16	76.0	16	43.0	11	0	...	
IX.	Wetherby (Ribston Hall) ..	1.32	-.86	.56	16	8	...	...	...	...	...	...	
"	Skipton (Arndcliffe) ...	5.16	-.48	.69	7	24	76.0	20	40.0	11	0	...	
"	Hull (People's Park) ...	1.57	-.102	.28	23	15	...	...	...	...	...	...	
X.	North Shields ...	1.43	-.196	.50	2	15	74.5	30	...	...	...	...	
X.	Borrowdale (Seathwaite)...	13.43	+ 2.44	2.14	29	22	...	...	...	...	...	...	
XI.	Cardiff (Ely) ...	3.47	-.59	.80	7	19	...	...	...	...	...	...	
"	Haverfordwest ...	4.15	-.06	1.05	7	19	70.0	21	40.5	9	0	...	
"	Plinlimmon (Cwmsymlog) ...	5.81	...	.91	30	20	...	...	...	...	...	...	
"	Llandudno ...	1.64	-.136	.25	25	14	69.2	13c	45.0	12	0	...	
XII.	Cargen [Dumfries] ...	3.23	-.70	.56	7	19	69.6	21	41.0	11	0	...	
"	Jedburgh (Sunnyside) ...	2.23	-.121	.62	7	17	71.0	21	39.0	20	0	...	
XIV.	Old Cumnock ...	4.36	+ .84	.63	14	23	73.0	13	36.0	10	0	...	
XV.	Lochgilphed (Kilmory)....	4.59	+ .29	.63	13	21	...	...	...	...	...	...	
"	Oban (Craigvarren) ...	6.07	...	2.47	13	19	65.2	2	43.3	8	0	...	
"	Mull (Quinish) ...	6.05	+ 2.00	.79	13	25	...	...	...	...	...	...	
XVI.	Loch Leven Sluices ...	3.20	-.42	1.00	8	14	...	...	...	...	...	...	
"	Dundee (Eastern Necropolis)	3.25	-.21	.95	7	17	77.6	21	43.2	10	0	...	
XVII.	Braemar ...	3.35	+ .14	1.11	7	22	69.8	21	36.8	26	0	1	
"	Aberdeen (Cranford) ...	2.42	...	1.12	7	23	74.0	31	40.0	19	0	...	
XVIII.	Strome Ferry ...	6.94	+ 2.65	.90	12	23	63.0	23	...	...	...	...	
"	Culloden ...	3.45	+ .46	1.02	14	...	69.0	20	41.0	16	0	1	
XIX.	Dunrobin ...	2.64	-.21	.78	12	18	...	...	...	...	...	...	
"	S. Ronaldsay (Roeberry)....	...	...	...	...	...	...	...	...	...	...	...	
XX.	Cork (Blackrock) ...	2.40	-.78	.52	7	16	75.0	21	42.0	3	0	...	
"	Dromore Castle ...	4.99	+ .01	1.50	30	16	68.0	24	43.0	16	0	...	
"	Waterford (Brook Lodge) ...	2.40	-.13	.54	7	17	75.5	21	42.0	10h	0	...	
"	O'Briensbridge (Ross) ...	2.99	...	.65	25	22	76.0	27	44.0	7i	0	...	
XXI.	Carlow (Browne's Hill) ...	1.78	-.174	.32	7	17	...	...	...	...	...	...	
"	Dublin (Fitz William Square)	2.17	-.51	.38	25	24	72.8	13	44.4	5	0	0	
XXII.	Ballinasloe ...	2.81	-.74	.62	25	19	67.0	13d	37.0	11	0	...	
XXIII.	Waringstown ...	2.77	-.75	.70	16	21	73.0	19e	44.0	1, 17	0	...	
"	Londonderry (Creggan Res.).	4.01	-.11	.65	13	26	...	...	...	...	...	...	
"	Omagh (Edenfel) ...	2.66	-.106	.65	30	24	68.0	13	43.0	10	0	...	

b And 23. c And 14. d And 31. e And 22, 25. f And 10, 12. g And 12.
h And 17. i And 8, 9.

+ Shows that the fall was above the average ; - that it was below it.

METEOROLOGICAL NOTES ON JULY, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A very wet month, with a phenomenal downpour on the 17th. This heavy fall laid the wheat extensively, and spoiled much hay. The excessively wet weather brought about the potatoe disease, and in some places the root crops are suffering from excessive E.

ADDINGTON.—Frequent R interrupted hay-making very much. A great quantity of hay was carried away by the large flood, resulting from the heavy E on the 17th. The nights were often very cold, 36° being registered on the grass once, and 37° twice.

BURY ST. EDMUNDS. WESTLEY.—Up to the 19th the weather was cold and very wet. The 2·70 in. recorded on 17th is the greatest fall registered in 24 hours since 1856, when observations commenced. The last part of the month was favourable for the corn crops, and helped them to recover from some of the damage caused by the exceptional R. Distant T on the 2nd.

LANGTON HERRING.—Another cold month, the weather throughout being very unsettled. On the 17th (the day of heavy R), only 21 in. fell here. The mean temp. at 9 a.m., 59°·9, was 3°·4 below the average, and the lowest in July for 19 years, with the exception of 1879. At 9 a.m. on 5th the temp. was only 52°, the lowest 9 a.m. reading in July for 19 years. Fog on several days.

BODMIN, FORE STREET.—A very wet, cold, and unseasonable month. T, L and heavy R on 16th.

WOOLSTASTON.—A dreary month, with cold nights and constant R, though there were no very heavy falls; most unfavourable for the hay crop, which was generally harvested in a damaged condition. Mean temp. 56°·9.

ORLETON.—The first 12 days very cold, the max. on no day reaching 70°, but the remainder of the month much warmer, there being only four days with a max. under 70°. Mean for the month about 1° below the average. The R again slightly below the average, making six months in succession with less than an average fall. T heard only on the 2nd. [In the table for June, the difference from the average should have been — 68 in. not + 68 in.]

LEICESTER, BARKBY.—“Catchy” weather for hay-getting. Crops rather light. Not much sunshine. L and T on the 2nd. T on 3rd.

HULL.—The weather during the month was rather showery, with a great amount of cloud, and sometimes with strong winds.

WALES.

HAVERFORDWEST.—The first week was cold and gloomy with strong gales, ending with a heavy fall of R; the second week was milder, but constantly wet and damp with a fine day in between, so it continued up to the 21st; from that to the 24th the weather improved considerably, warmer days and warm nights, with several hours of bright sunshine. Up to the 28th the weather continued tolerably fine, from that to the end very wet weather prevailed, with warm days and nights. The temp. of the month was below the average, and only once reached 70°. The potatoes are rotting extensively. Corn crops likely to be light in grain from the great absence of heat and sunlight. Hay harvesting late and precarious. Prevailing winds W., S.S.W., and N.W. There were 17 nights with the temp. below 50°, ten were at or below 45°.

SCOTLAND.

CARGEN.—The mean temp. of the month 56°·2 is 3°·1 below the average. With the exceptions of 1888 and 1862, it is the lowest for July during 30 years. The first part of the month was unusually inclement, the mean temp. of the

first 12 days being only 54°. The max. temp. never reached 70°, which with the exception of 1862, has not occurred before in July. The atmosphere throughout was highly charged with moisture, the hygrometer showing a mean difference between the dry and wet bulbs of only 1°·7, the average difference being 2°·6. There was no day on which sunshine did not occur for one or more hours, but the total number of hours is 55 hours below the average. T on the 2nd, 3rd and 4th, and H showers on 3rd.

JEDBURGH.—The temp. was below the average, still vegetation went on well. Crops of all kinds being in fair condition and promising an abundant yield. Health of the district very good.

CULLODEN.—Sunshine deficient, the hay crop suffering from the heavy rains, and harvest must be late.

IRELAND.

CORK.—Very changeable throughout, with cold winds and absence of sunshine. Mean temp. 59°·6, 2°·6 below the average of 14 years.

DROMORE.—A wet month, with very little summer weather. Very little prospect of turf fuel being got dry this year.

WATERFORD, BROOK LODGE.—The weather very broken all the month, and the temp. very low; mean 57°·5.

ROSS, O'BRIENSBRIDGE.—Very little sunshine, and vapour and fog even on days when no E fell. A bad month for hay.

DUBLIN.—A very unsettled, squally, showery, cool month. Rainfall, although frequent, perceptibly below the average.

OMAGH, EDENFEL.—Notwithstanding that E fell on 24 days, and that there was not a true "summer's day" during the month, the total fall is considerably under the average. A heavy crop of hay has been well saved, and all other crops promise great abundance.

PROF. HAZEN'S TABLES.

To the Editor of the Meteorological Magazine.

SIR,—I have been pleased at the kindly notice of my meteorological tables in the July number of this magazine. My agents in London are the well-known firm of W. Wesley, of Essex Street, Strand, and Hirschfeld Bros., from either of whom the book may be purchased.

As to rainfall conversions, I am inclined to think the table as given is more satisfactory than any table for single millimetres. It is a very simple matter, and very often more expeditious to work from the body of the table to the margin than *vice versa*. I will give a few examples. To convert millimetres to inches between 1 and 400, enter body of Table xxxi. for mms. and the inches will be found in the margin, *e.g.*, 114 mm. = 4·49 in. : 2,563 mm. = 100·9 in. : 8,103 mm. = 319·0 in., &c. To convert inches to millimetres for values above 32 in., move the decimal point one place to the right in Table xxxi, *e.g.*, 38·6 in. = 980·4 mm. : 319·9 in. = 8,125·4 mm., &c. The same plan of use will help us in getting feet into metres, and kilometres into miles.

H. A. HAZEN.

July 29th, 1890.

[Prof. Hazen is fully entitled to express his opinion, but we retain our own; if tables are so handy when used in the reverse direction, it is not obvious why any are given both ways.—ED. *M.M.*]

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCVI.]

SEPTEMBER, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

SUNBURN.

WHY do the pale denizens of cities become more rapidly brown in some localities than in others? This does not appear a very difficult question, and yet we are not sure that Dr. Bowles* has answered it perfectly. It is, of course, rash for any one not versed in physiology to even hint that a doctor may be wrong; and very possibly we shall have to pay the penalty and be one more proof of the proverb, which we prefer not to quote, as to certain persons entering where certain spirits are wiser. But we risk the penalty in order to obtain a certain and absolute reply to the question with which we began.

Dr. Bowles has for many years spent the early summer months (*i.e.*, before the majority of tourists go there, and before much of the snow is melted) in the Alps, and in the pamphlet we have quoted strings together his experience. On the very first page there is a paragraph which epitomizes so much that we quote it verbatim:—

“It will, I think, be readily conceded by Alpine climbers that sun on snow burns more quickly than on rocks or in the heated valleys at a lower elevation, although one may feel the heat more in the two latter situations; it is when one reaches the snow that one adopts veils, masks, and snow-glasses.”

In order to put Dr. Bowles's case quite clearly, we must set out in as few words as possible the principal arguments and statements in the pamphlet. All persons, however, who desire to master the subject must go back to the pamphlet and read every word of it. Now for the epitome.

- (1) Glass workers, iron workers, and many others exposed to intense heat do not suffer from sunburn.
- (2) Although it is much hotter in valleys than on snow-covered mountains, sunburn is found only in the cooler place.
- (3) One may lie long on one's back with the face exposed to the sun, and yet not become sunburnt; therefore heat alone is not the cause.

* “Sunburn on the Alps,” by Robert L. Bowles, M.D., F.R.C.P. (Lond.) London, Stanford, 1890. 8vo., 20 pages.

- (4) Dr. Tyndall said that he was never more burnt on Alpine snows than while experimenting with the electric light at the North Foreland, where the heat was not great, and there was no snow.
- (5) A gentleman crossed the Findelen glacier to ascend the Findelen Rothhorn (11,214 ft.); he felt no inconvenience until he was near the top, and then for about ten minutes he was on new snow; in five minutes he began to feel sunburn, and in the evening the symptoms were fully developed.
- (6) A gentleman and lady say that they were never more sunburnt than on a day without a gleam of sun, on which they ascended the Pigne d' Arolla (12,472 ft.). They were so enveloped in cloud that the guides nearly lost their way, and it was so cold that the lady's hands were blue and senseless.
- (7) Dr. Bowles, in order to try the preservative effect of colour, painted his face brown, and on a brilliant day, when there was much snow, ascended the Gorner Grat (10,289 ft.), accompanied by about 80 persons out of the 100 staying at the Riffel Hotel. Everyone, except Dr. Bowles, who made the ascent suffered in the evening from sunburn, but he, and the 20 who had remained near the hotel, escaped.
- (8) The Fijians, who usually paint their faces with red and white stripes, invariably blacken them when they go fishing on the reef in the full glare of the sun.
- (9) On the Sikhim Hills the natives blacken the skin round their eyes to palliate the glare of the sun from fresh snow.
- (10) Those who winter at Davos (5,105 ft.) become extremely brown, more so than those who are there in summer, unless the latter go above the snow line.
- (11) Such portions of the wood of chalets, in lofty situations, as are protected from snow glare are a dirty white; those exposed to it are brown.

Dr. Bowles considers that—

- (12) Heat *qua* heat is not the cause of sunburn.
- (13) Sunburn is probably due to ultra violet rays reflected from snow.
- (14) Altitude alone does not explain sunburn; one may be free from it among rocks at 10,000 ft., and suffer on descending to 6,000 ft. among snow.
- (15) Captain Abney finds an excess of violet or ultra violet rays at great altitudes, and thinks that sunburn depends largely on altitude.
- (16) Prof. Langley thus describes his experience when climbing to the summit of Mount Whitney (15,000 ft.) :—

"In the desert at the bottom of the mountain the heat was found almost

unbearable—237° in the sun, and not much less in the tent.* And now come the points of interest in relation to my own observations on Sunburn. The desert sun had tanned the faces of the travellers to, 'a leather-like brown.' As they ascended they found the cooler air delightful, 'but soon,' says Professor Langley, 'the cooler it grew the more the sun burnt the skin—quite literally burnt, I may say, so that by the end of the third day my face and hands, case-hardened as I thought in the desert, began to look as if they had been seared with red-hot irons, here in the cold where the thermometer had fallen to freezing at night; and still as we ascended the paradoxical effect increased; the colder it grew about us, the hotter the sun blazed above. We have all heard probably of this curious effect of burning in the midst of cold, and some of us may have experienced it in the Alps, where it may be aided by reflection from the snow, which we did not have about us at any time except in scattered patches; but here by the end of the fourth day my face was scarcely recognizable, and it almost seemed as though sunbeams up here were different things, and contained something which the air filters out before they reach us in our customary abodes. Radiation here is increased by the absence of water vapour too, and on the whole this intimate personal experience fell in almost too well with our anticipations that the air is even a more elaborate trap to catch sunbeams than had been surmised, and that this effect of selective absorption and radiation was intimately connected with that change of the primal energies and primal colour of the sun which we had climbed towards [it] to study.'"

We have already intimated that we criticize this pamphlet chiefly in order to elicit further information, and with perfect readiness—nay, desire—to be corrected where we go wrong.

As regards 2 it is as well explained by 15 as by 13.

As 3 is a distinct statement, we cannot say more than that we were not previously aware of it.

How does the author reconcile 4 and 6 with 13?

8 does not seem to show more than that precautions are necessary where there is no snow.

Considering the difference between a man's face and a fir plank, the support derived from the fact stated in 11 does not seem great.

* Feeling sure that this statement required explanation, we have obtained a copy of the lecture given by Prof. Langley at the Royal Institution, which Dr. Bowles has paraphrased in the above words. But he has not quite caught the facts as then stated by Prof. Langley, who said, "Close by these tents a thermometer, covered by a single sheet of glass, and surrounded by wool, rose to 237° in the sun, and sometimes in the tent which was darkened for the study of separate rays, the heat was absolutely beyond human endurance." The temperature in such a box proves little; we have seen it above 212° in England, and from an examination of Prof. Langley's official report, we fancy that he was quoting from memory, mixing up his low level and high level observations, and giving the reading of 236° which occurred, not at Lone Pine 3760 ft., but at Mountain Camp, 11,625 ft. above sea level, and when the air temperature was only 60°·8! That it was very hot in the dark tent at the low level station at Lone Pine we do not doubt, but the highest shade temperature that we can find recorded there was 91°·5 at 0·35 p.m., on August 20th, 1881, when the wet bulb (with a bad covering) read 61°·4, so that the air was extremely dry, and therefore the heat would not be serious—of course, in a dark tent it would be uncomfortable.

14 and 15 do not agree, and 16 (when toned down to less vivid language) implies that sunburn may be due to (A) the direct heating rays of the sun, (B) increased altitude, or (C) increased dryness.

We are not quite clear as to what the author calls sunburn, because sometimes he seems to imply merely the browning of the skin, at other times he refers to "face . . . immensely swollen, red and painful . . . all covered with yellow blisters." When these blisters peel off, is the new skin brown?

BROCKEN SPECTRE IN THE LAKE DISTRICT.

RETURNING yesterday, August 27th, from an ascent of Scawfell Pike with my friend Charles James Spence, of Newcastle, and our sons, we were witnesses of a rare and striking spectacle. It had rained doggedly for two hours during our descent on the Piers Ghyll side, heavy clouds beneath us obscuring the valley. Taking the most direct line for Buttermere, we went over the summit of Base Brown, 2,100 ft., by which time the rain had ceased. The mist clouds were rising and curling majestically up the sides of the mountain ranges around us, and when the sunlight, almost suddenly, at 6.15 p.m., shot through a break in the clouds, above Brandreth on our west, we all at once observed a circular double rainbow athwart the mist-cloud on the opposite, or Borrowdale, side of us. The colours were perfect, although not particularly brilliant; and the two rings of each series of colours were complete. The figures of our party were represented in shadow right across the double rainbow circle, considerably magnified, and every movement we made of our arms and legs, and the waving of our hats and waterproofs, was pantomimically repeated by our gigantic and glorified counterparts. This exciting spectacle lasted about six or seven minutes.

I have been tolerably familiar with Cumberland mountain scenery for the last forty years, and have made many ascents at all times of the day and night, but this is the first time I have witnessed this beautiful phenomenon, and as it is rare, it may be worth while to place it on record.—EDMUND PROCTOR, Loweswater, Cockermouth.
—*Pall Mall Gazette*.

ERRATA IN "METEOROLOGICAL MAGAZINE," 1889.

REGULAR TABLE.

Strathfield Turgis,	Nov., should be...	...	'84 in.
Boston,	March, " " ...	...	2'17 "
Wetherby, Ribston Hall,	July, " " ...	...	1'69 "
Lochgilthead, Kilmory,	Dec., " " ...	...	7'96 "

SUPPLEMENTARY TABLE.

Wakefield	July, should be...	...	1'51 in.
"	Aug., " " ...	...	3'56 "
"	Nov., " " ...	...	'75 "
Llanfrechfa Grange,	May, " " ...	...	3'86 "
New Galloway, Glenlee,	Sept., " " ...	...	2'07 "
Tipperary, Henry Street,	Jan., " " ...	...	2'99 "
Galway, Queen's College,	Jan., " " ...	...	3'72 "
" " "	April, " " ...	...	2'01 "

TWO TORRENTIAL RAINS ON AUGUST 19TH.

To the Editor of the Meteorological Magazine.

SIR,—We have had another heavy rain in this locality which you may be glad to hear of. It lasted about the same time as the July rain, but came down more in heavy storms than that rain, though it did not, I believe, cease raining all the time. It began a little before seven on the evening of the 19th, and continued to about 5 a.m. on the 20th. Here I registered 2·34 in.; at the Abingdon Sewage Farm, a quarter of a mile west of this, 1·85 in.; at Long Wittenham, one gauge 1·50 in., the other 1·58 in.; at Milton Hill, about three miles south, just under the Berkshire downs, 3·80 in. was registered, but unfortunately the gauge overflowed, but not, it is believed, to any great extent. I imagine that the heavy rainfall must have been very local, as the weather reports do not speak of any heavy rainfall.—I am, yours faithfully,

F. C. CLUTTERBUCK.

Culham Vicarage, Abingdon, August 22nd, 1890.

SIR,—The rainfall at Upminster, both for July and August, was over $4\frac{1}{2}$ inches, but on only one occasion did we get the fringe of what you describe as “torrential” rain, viz., August 19th, when 1·47 in. fell in about two hours; but a mile north, in a band between Brentwood and Harold Wood, stretching from Little Warley to Noak Hill, the fall was greater than I have ever seen, and even now some of the roads are like a sea beach or the beds of mountain torrents. The rain fell in short, sharp showers, with large hot drops, and even on the sides of some of the hills was running nearly two inches deep. On my way home there was no rain at Ilford, and at Romford only a little, while at Harold Wood the water was running down the line (G.E.R.), washing the sleepers out. I could only just get over the Ingrebourne at Harold Wood, and a little farther on the water came up to the bottom of my cart, and the roar of the water and rain was so great that I could scarcely hear the thunder. About half a mile on I went out of the storm like going out of a wall of water. I know of no rain gauge in this district, but a visit to the district even now would convince you that my story is not overdrawn.—Yours faithfully,

G. P. HOPE.

Upminster Hall, Essex, September 4th.

N.B.—In some places the water rose above the marks of August 1st, two years ago.

AUTUMN CONGRESSES.

FOR some persons there is no peace. Three autumnal congresses have already been held, at each of which meteorological subjects have been discussed.

The Association Française met at Limoges, under the presidency of one of the greatest physicists of the present day, Prof. Cornu, who delivered one of those delightful addresses for which he has an unequalled reputation. We have not a complete list of the members present, but we see that Prof. Ragona, of Modena, and Mr. Lawrence Rotch, of the Blue Hill Observatory, were there as Honorary Presidents, M. Leon Teisserenc de Bort as President, and Dr. Fines as Vice-President, so that it was evidently a strong, if not large gathering. As we understand that the papers and proceedings will be reported in our contemporary the *American Meteorological Journal*, we refer our readers to its pages, as it is unwise to set up the same details in both journals.

The Sanitary Institute held its Congress at Brighton, and naturally a paper on the climate of that excellent health resort was among the best sent in—from it we have drawn up the following abstract.

On "The Climate of Brighton," by F. E. SAWYER, F.S.A.

TEMPERATURE.

The proximity of Brighton to the sea affects its climate in three ways :—

1. By reducing the mean daily range of temperature.
2. By raising the temperature in the winter months.
3. By lowering the temperature in the summer months.

The appendix to this paper contains a summary of meteorological observations for more than twenty years. From Table I. it will be seen the mean daily range of temperature yearly was 11·8 deg.; being 15·9 deg. in June, diminishing to 7·7 deg. in January. These daily ranges are of course small compared with those of inland places. The lowest temperature was 11·4 deg. on January 22nd, 1881 (the time of "the great snow-storm"). On the 15th of that month the min. temp. was 15·5 deg.; on the 17th, 16·7 deg.; and the 20th, 17·3 deg. With the exception of these four days no lower temperature than 18 deg. was recorded, viz., in December, 1870 (the winter of the Franco-Prussian War). This clearly shows the influence of the sea, as in the interior of the country we find the temperature fell below zero at many places. Fashion has, perhaps, somewhat empirically, fixed the Brighton season for the period from the end of September to the middle of December; and it is a curious fact that it is then that the advantages of Brighton are most apparent, the chills of autumn being avoided, and the mean

temperature in excess of that at Greenwich, as will be seen by the following table :—

MEAN MONTHLY TEMPERATURE.			
(arithmetical mean daily max. and min. temperatures.)			
	BRIGHTON. GREENWICH. DIFFERENCE.		
	deg.	deg.	deg.
September	58·0	56·6	— 1·4
October	50·4	49·5	— ·9
November	43·8	42·4	— 1·4
Mean	50·7	49·5	— 1·2

The mitigating influence of the sea on the heat of summer is proved by the fact that the temperature has not risen above 90 deg. The highest in my own register during twenty-three years, being 86·7 deg. on July 17th, 1868. During the summer months the well-known phenomena of the land and sea breezes are particularly noticeable at Brighton, the most marked being the easterly. The land breeze N.E. or E. blows until from 10 to 11 a.m., and a morning will open very sultry and oppressive until the cool sea breeze sets in. This lasts until sunset, or sometimes until midnight, when the land breezes begin again. A cool and comfortable day is thus enjoyed, even in the height of summer. When these breezes are westerly, the land breeze is from N.W. or W., and the sea breeze from the S.W. or S., occasionally S.E. Sometimes the land breeze begins in N.E., is followed by S. or S.W. sea breeze and then a N.W. or N. land breeze again, or the reverse way, but this is not often.

The mean temperature of the year (arithmetical mean of daily max. and min. temperatures) is 49·8 deg., the monthly means ranging from 63 deg. in July to 38·8 deg. in January. The warmest month in the last twenty-three years was July, 1868, with a mean of 66·8 deg., and the coldest January, 1881, with one of 33·2 deg.

WIND.

The climate of Brighton has been classed amongst the *bracing*, but this must be from the fact that its pure air is almost always in motion rather than from any lowness of temperature, which, as already seen, is not experienced here.

From September, 1872, to December, 1874, the velocity of the wind was recorded by a Robinson's anemometer, erected at the Chain Pier-head, Brighton; and from the observations of twenty-seven months it appears that the mean horizontal distance travelled by the wind daily during that period was 329 miles, or 13·7 miles per hour, so that there is no lack of fresh air.

RAINFALL.

The mean annual rainfall of twenty years was 28·35 inches; and, as will be seen by Table III., the most rainy month is November, with a total of 3·40 inches; and the driest March, with 1·67 inches.

The greatest fall in twenty-four hours was 1.99 inches, on June 22nd, 1876, being the largest recorded by any observer in Brighton. It is somewhat remarkable that no heavier fall of rain has occurred, but it may be due to the fact that the town is very free from thunderstorms.

(*To be continued*).

THUNDERSTORM, AUGUST 2ND.

To the Editor of the Meteorological Magazine.

SIR,—I now give you an account of a singular storm of which I was witness on August 2nd (Saturday last). It threatened rain, and thunder was heard at 3 p.m.; but that storm passed by, and I ordered the carriage to take me to a neighbour's about six miles off this place to the S.W. The house stands on an eminence, and the window of our room faces almost due N. From this window, about 5 p.m., I watched the approach of a fresh storm. The view commanded about three miles of plain, backed by wooded high ground. Having passed this high ground, the cloud swept on exactly like a black pall trailed over the surface of the ground. In front of it, and rising from the ground, was a sparse white cloud, which I took to be smoke. It was not, however, smoke, but vapour, for when the storm had passed on to be exactly over the house there showed in front of it a quantity of white curling vapour not more than 100 feet high. The rain was violent, and there were some claps of thunder, the lightning being vivid and *red*, as it always is when seen through vapour.

I account for the smoke-like vapour thus:—Just before, at 3 p.m., as I said, there had been a copious shower, followed by bright sunshine, which permitted of rapid evaporation of all the drops that hung in the vegetation. Then, when the air was full, during the bright sunshine, of invisible vapour, came the dark thick thundercloud, which suddenly reducing the temperature, caused the ascending vapour to become visible, and so seemed to swallow it up and carry it on with it, filling up the usual space between the ground and a cloud with newly-formed visible vapour.

The rainfall with us was not great for both showers together, 0.16 in. only.—Yours truly,

JOHN SLATTER.

Whitchurch (Oxon.), near Reading, August 8th, 1890.

REMARKS ON THE DISCUSSION CONCERNING BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—Prof. Hazen's letter has suggested to me the following calculation, which may perhaps interest some of your readers :—

A fall of 1·00 inch of rain supplies a little over 5 lbs. of water to each square foot of surface, and the latent heat set free by the condensation of this water at ordinary temperatures is about 5,000 thermal units. Taking Joule's mechanical equivalent of heat as 772 foot pounds, we get the large amount of 3,860,000 foot pounds of energy set free over every square foot of the earth's surface on which rain falls to the depth of 1·00 in. The weight of air resting on each square foot is about 2,100 lbs. ; and thus, if the whole energy were used in imparting motion to this air, we should get the extreme velocity of about 240 miles per hour in the whole mass of air resting upon the rainfall area. For a velocity of 60 miles per hour, which is seldom exceeded in our most violent gales, only $(\frac{1}{4})^2$ of 1·00, that is, less than ·07 in. of rain, is required.

No doubt the whole of the energy set free does not take the form of direct motion ; but a large part of it must go to raising the temperature of the air, or perhaps it should be said, to counteracting the fall of temperature which causes the rain ; still, considering the small proportion of the energy that is required, even when the rain which accompanies the cyclone is moderate, it is strange that anyone should say that the cause is incapable of producing the effect.

Of course, it does not follow that because the cause assigned by Prof. Ferrel is capable of producing the effects, it must therefore be the actual cause, but it seems only reasonable to suppose that when such a large supply of energy is afforded by the condensation of vapour, some small part of it should take the form of kinetic energy and appear as wind, and I agree with Mr. Clement Ley in thinking that the indications of Prof. Ferrel's theory being the true one are unmistakable.

W. H. DINES.

SIR,—Some of your readers will, I hope, be grateful to me for having, by the mention of his name, elicited a letter from Prof. Hazen. It is common and natural that those who are in a minority should deny that their arguments "have had full attention paid to them." For my own part, I have given much attention to Prof. Hazen's publications, and I do not think that all his arguments should be "ignored as unworthy of attention." That he sometimes makes a statement which is not strictly permissible to a scientific man, and which even reads like one of the expressions of the opponents of science, is shown by the last sentence of his letter in this Magazine for August, 1890, p. 101. The law on which Ferrel's theory is chiefly based has been rightly stated by Messrs. Davis and

Curry to be "thoroughly in accord with well-tried physical principles ; it has been abundantly tested by experiment, both on a small scale in the laboratory and, as we may say, on a large scale in nature ; it is universally accepted by men eminent in physical study, whose original ability and careful studious work have led them to be regarded as authorities in their science, but who, being authorities, have not thereby become arbitrary and irrational. It is therefore difficult to understand why the question should be so confused by Hazen, as appears in his recent articles."

I did not, as it happens, either state or imply that the work of W. Ferrel is "fundamental and conclusive," but I implied and unhesitatingly state that no one at the present day can expect to receive attention on the subject of the formation of barometric depressions who has not given full attention to Ferrel's writings. Prof. Hazen says that I ought to have mentioned that Ferrel is "second in the field," because he draws largely (as does every scientific man) from the works of his predecessors. Ferrel derives many ideas not only from numerous cis-Atlantic predecessors, but perhaps especially from Espy, to whose work he refers not fewer than ten times in his latest treatise. Prof. Hazen himself gives a specimen of one of such references : and a student who, following my advice, reads Ferrel's works, will find this out for himself, even supposing him actually to have never heard of the "Philosophy of Storms" before. Prof. Hazen would, I presume, think it unjust to recommend the study of the works of the greatest living mathematicians, unless he at the same time mentioned Lagrange ?

There is one remark of Prof. Hazen's which is suggestive. He speaks of the "inwardness" noticeable in American meteorologists. If he means that most of them give undue prominence to American sources of information, he ought, I think, to except Ferrel. If, on the other hand, he means that some of them (*pre-eminently and beyond all other men* Ferrel himself) combine with the studious collection of observations and thorough sifting of *objective* facts abundance of *subjective* and intellectual reasoning and careful mathematical demonstration, I for one cordially agree with him. The same may be said of many of our great continental meteorologists. I wish it were equally true of ourselves. To make, collect, and pigeon-hole as many observations as possible seems to be the sole object of many whom we term "meteorologists" in England. But this fact would not of itself deter many of our own ablest mathematicians from the study of meteorological problems. It is the unfortunate fecundity of pet theories, propagated by those who think a little but who do not read at all, belonging to a race which is somewhat lazy and, from a linguistic point of view, very "inward" indeed, which has lent a deterrent aspect of quackery to a most interesting branch of science. Let me take a single example from the discussion I have roughly reviewed. One writer, who is ostentatiously and professedly a non-reader, supposes our anti-cyclones and cyclones to result from air-

waves with interspaces between them, flowing polewards from the equatorial regions, unobserved over the trades, and (as I presume) the monsoons, unobserved over the tropical belts of high pressure, spreading themselves out laterally (over converging meridians), and causing our changes of pressure and weather—(*Met. Mag.*, July, 1890, p. 86)—and he both imagines this idea to be new, and apparently thinks it altogether the better for being new! How rarely do we meet with an English Guldberg, Mohn, Reye, Hann, Köppen, Woelfkoff, Sprung, Ekholm, Vettin, Van Bebbber, Hertz, or Helmann! How few are the meteorological treatises by an English Helmholtz. And I might well multiply names, not of *absolute authorities*, but of important writers. If the cause of this our great lack be what I suppose, we should endeavour to remedy it.—
Yours truly,

W. CLEMENT LEY.

HAILSTORM, AUGUST 24TH.

SIR,—A somewhat remarkable hailstorm occurred here yesterday evening. Having been, in this locality, unaccompanied by thunder and lightning, it will not be reported in thunderstorm observations; but it was in some respects phenomenal. The day had been on the whole fine, but with passing showers, and many Cumulo-Nimbi. The min. temp. of the previous night had been very low, 40°0 at a height of five feet from the ground. The cloud formed apparently at a short distance N.W. of the town, and rapidly increased in size and extent. Large drops of rain began to fall about 5.25 p.m., which soon changed to hail, which fell with extraordinary persistency for quite 15 minutes. The stones were of a uniform size, the largest the size of large peas. The lawn was quite white, and remained so for some time after the hail ceased, notwithstanding heavy rain, which lasted intermittently till after 6.30 p.m. The stones were drifted several inches deep in the corners of windows facing the storm. The characteristic of the storm was more that of the soft hail frequent in the spring months than of a summer thunderstorm; and this was fortunate, or from the thickness with which the hail fell, the damage would have been enormous. As I said before, no electrical phenomena occurred here, though I see that in London there was a violent thunderstorm. The shower was quite local. The evening, after 7 p.m., was clear and cold, barometer nearly steady at 29.67 in.; total fall of rain during the storm, 0.65 in., and during the 24 hours ending at 9 a.m. to-day, 0.68 in.—Your truly,
C. N. PEARSON.

24, Portland Place, Reading, August 25th, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, FEB., 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	49·3	1	27·1	28	43·4	33·2	34·2	87	83·4	21·8	1·05	9	0-10
Malta.....	67·1	20	42·7	13	59·6	49·9	46·5	80	121·2	38·9	5·14	10	5·5
<i>Cape of Good Hope</i> ...	92·0	14a	50·0	1	78·4	39·9	...	...	...	...	1·27	...	3·8
<i>Mauritius</i>	84·0	19	68·6	2	81·8	73·0	70·8	83	138·7	63·1	11·02	27	6·4
Calcutta.....	90·8	26	50·7	12	83·5	59·5	58·6	67	143·4	40·5	·00	0	0·7
Bombay.....	89·6	22	67·6	4, 9	85·2	70·6	66·2	67	138·8	54·8	·00	...	0·7
Ceylon, Colombo	90·5	10	69·3	8	87·3	72·3	69·2	74	145·0	63·7	4·36	10	3·4
<i>Melbourne</i>	103·4	6	52·5	24	82·0	60·4	56·4	63	152·3	43·5	·56	5	5·3
<i>Adelaide</i>	97·4	2	56·0	9	85·0	64·0	56·4	54	162·0	47·4	1·93	3	3·3
<i>Wellington</i>	82·0	10	43·0	9	71·4	54·7	51·9	67	139·0	34·0	·24	5	3·7
<i>Auckland</i>	82·0	11	52·0	3	76·4	60·2	54·2	61	147·0	46·0	·07	3	3·7
Jamaica, Kingston.....	89·1	25	60·2	4	86·9	64·2	65·9	74	...	...	·37	...	...
Trinidad	88·0	25	62·5	12	85·1	66·0	66·6	78	157·0	60·0	·51	6	...
Toronto	53·8	4	3·0	21	35·6	19·7	25·5	85	...	0·0	3·48	22	8·2
New Brunswick, Fredericton.....	47·8	...	—20·9	...	27·6	2·1	16·3	75	...	...	4·17	13	4·9
Manitoba, Winnipeg.....	35·3	13	—36·4	26	5·7	—19·1	—1·5	97	...	...	·82	11	4·7
British Columbia, Victoria.....	49·0	5	12·0	26	29·0	28·9	...	...	...	...	2·33	10	...

a And 22.

REMARKS, FEBRUARY, 1890.

MALTA.—Mean temp. 54°·1; mean hourly velocity of wind 12·7 miles. Sea temp. fell to 58°·9. TSS on 5 days; L on 8th; H on 3rd, 7th and 12th; B nearly four times the average. J. SCOLES.

Mauritius.—Mean temp. of air 1°·4 below, of dew point 0°·8 above, and R 4·81 in. above, their respective averages. Mean hourly velocity of wind 7·9 miles, or 3·3 miles below average; extremes, 21·2 on 17th, and 1·7 on 1st; prevailing direction of wind, E.S.E. to E. by N. T and L on six days; T on three days, and L on two days.

C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on three days, and L was seen on five other days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 4°·8, and of dew point 3°·2 above average. Humidity 3, and R 1·36 in., below average. Prevailing direction of wind S.E. and S. Strong on eight days. The weather during the greater part of the month was very sultry and hazy, and during the earlier part, at times very oppressive. L in S.W., and W. on the evening of the 12th. R. L. J. ELLERY, F.R.S.

Adelaide.—Continued hot weather during the first part of the month, then comparatively mild; mean temp. 0°·7 above the average of 33 years; mean pressure slightly below average. C. TODD, F.R.S.

Wellington.—Very fine weather during this month, with little rainfall. Prevailing winds S.E. and S., strong on three days from N.W. Mean temp. 0°·6 above the average. R less than one twelfth of the average. R. B. GORE.

Auckland.—A fine, hot, and almost rainless month. Bar. slightly above the average. Mean temp. 1° above the average; R almost nil, and the least ever recorded for any month in Auckland. T. F. CHEESEMAN.

TRINIDAD.—R 1·30 in. below the average of 25 years. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL, AUGUST, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	3.02	XI.	Castle Malgwyn	2.69
"	Margate, Birchington...	3.70	"	Builth(Llanwrtyd Wells)	6.40
"	Littlehampton	2.52	"	Rhayader, Nantgwillt..	7.08
"	Hailham	3.95	"	Carno, Tybrith	5.57
"	Ryde, Thornbrough	3.99	"	Corwen, Rhug	4.80
"	Alton, Ashdell	3.63	"	I. of Man, Douglas	3.84
III.	Oxford, Magdalen Col...	2.26	XII.	Stoneykirk, Ardwell Ho.	2.94
"	Banbury, Bloxham	1.98	"	New Galloway, Glenlee	3.09
"	Northampton	1.60	"	Melrose, Abbey Gate...	4.95
"	Cambridge, Fulbourne..	1.33	XIII.	N. Esk Res. [Penicuik]	5.60
"	Wisbech, Bank House..	2.07	XIV.	Ballantrae, Glendrisaig	2.34
IV.	Southend	2.83	"	Glasgow, Queen's Park.	3.16
"	Harlow, Sheering	2.78	XV.	Islay, Gruinart School..	5.10
"	Rendlesham Hall	2.05	XVI.	Dollar	2.80
"	Diss	2.44	"	Balquhiddie, Stronvar..	3.66
"	Swaffham	2.63	"	Coupar Angus Station..	2.05
V.	Salisbury, Alderbury ...	2.62	"	Dunkeld, Inver Braan..	2.36
"	Warminster	2.73	"	Dalnaspidal H.R.S. ...	4.18
"	Bishop's Cannings	2.36	XVII.	Keith H.R.S.	4.78
"	Ashburton, Holne Vic....	...	"	Forres H.R.S.	4.55
"	Hatherleigh, Winsford.	3.31	XVIII.	Fearn, Lower Pitkerrie.	3.76
"	Lynmouth, Glenthorne.	4.11	"	Loch Shiel, Glenaladale	9.82
"	Probus, Lamellyn	3.52	"	N. Uist, Loch Maddy ...	3.66
"	Launceston, S. Petherwin	4.00	"	Invergarry	4.07
"	Wincanton, Stowell Rec.	3.12	"	Aviemore H.R.S.	2.89
"	Taunton, Lydeard Ho....	...	"	Loch Ness, Drumnadrochit	3.25
"	Wells, Westbury	2.92	XIX.	Lairg H.R.S.	3.42
VI.	Bristol, Clifton	2.93	"	Scourie	6.14
"	Ross	2.92	"	Watten H.R.S.	3.83
"	Wem, Clive Vicarage ...	3.18	XX.	Dunmanway, Coolkelure	3.95
"	Cheadle, The Heath Ho.	3.56	"	Fermoy, Gas Works ...	1.79
"	Worcester, Diglis Lock	2.44	"	Tipperary, Henry Street	2.86
"	Coventry, Coundon	2.98	"	Limerick, Kilcornan ...	2.60
VII.	Ketton Hall [Stamford]	1.76	"	Miltown Malbay	4.77
"	Grantham, Stainby	2.26	XXI.	Gorey, Courtown House	2.61
"	Horncastle, Bucknall ...	1.65	"	Navan, Balrath	3.68
"	Worksop (Hodsock Priory)	2.15	"	Mullingar, Belvedere ...	2.93
VIII.	Neston, Hinderton	4.30	"	Athlone, Twyford	2.62
"	Knutsford, Heathside ...	3.85	"	Longford, Currygrane...	3.04
"	Lancaster, South Road.	6.57	XXII.	Galway, Queen's Coll...	2.86
"	Broughton-in-Furness ...	6.90	"	Clifden, Kylemore	4.59
IX.	Wakefield Prison	3.41	"	Crossmolina, Enniscoe..	4.36
"	Ripon, Mickley	5.12	"	Collooney, Markree Obs.	5.04
"	Scarborough, West Bank	3.87	"	Ballinamore, Lawderdale	3.98
"	East Layton [Darlington]	5.39	XXIII.	Warrenpoint	2.87
"	Middleton, Mickleton...	5.63	"	Seaford	3.05
X.	Haltwhistle, Unthank...	6.54	"	Belfast, New Barnsley..	3.58
"	Shap, Copy Hill	5.71	"	Bushmills, Dundarave...	4.69
XI.	Llanfrechfa Grange	3.46	"	Stewartstown	3.08
"	Llandovery	4.77	"	Buncrana	5.20

AUGUST, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE				No. of Night below 32°	
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Days on which no or more fell.	Max.		Min.		In shade.	On grass.	
				Dpth.	Date.		Deg.	Date.	Deg.	Date.			
I.	London (Camden Square) ...	1.55	— .33	.40	19	18	79.7	5	40.4	31	0	0	
II.	Maidstone (Hunton Court)...	2.49	+ .80	.68	26	14	...	...	...	...	...	...	
III.	Strathfield Turgiss	2.31	+ .60	.81	19	14	78.8	5	36.0	30	0	1	
III.	Hitchin	2.03	+ .21	.43	19	18	75.0	5	39.0	31	0	...	
IV.	Winslow (Addington)	1.99	+ .02	.32	26	16	80.0	5	34.0	30	0	1	
IV.	Bury St. Edmunds (Westley)	2.20	.00	1.15	10	13	...	...	...	...	...	...	
V.	Norwich (Cossey)	1.87	...	.57	10	14	...	...	...	...	...	...	
V.	Weymouth (Langton Herring)	2.19	+ .26	.58	9	20	73.0	9, 12	45.0	30	0	...	
"	Barnstaple	3.03	+ .07	.97	9	17	77.0	8	45.0	29	0	...	
"	Bodmin (Fore Street)	3.62	+ .77	.47	9	20	...	...	...	...	...	...	
VI.	Stroud (Upfield)	2.82	+ .73	.85	9	18	79.0	6	39.0	29	0	...	
"	Churchstretton (Woolstaston)	4.16	+ 1.40	.91	1	20	72.0	4	42.0	30	0	...	
"	Tenbury (Orleton)	2.79	+ .67	.38	10	19	77.8	4	33.8	30	0	1	
VII.	Leicester (Barkby)	2.59	+ .15	.57	22	21	87.0	5	31.0	31	2	4	
"	Boston	1.15	+ .97	.32	10	15	87.0	5	41.0	30	0	...	
"	Healey Hall (Tickhill)	2.68	+ .52	1.02	10	18	80.0	5	38.0	31	0	...	
VIII.	Manchester (Plymouth Grove)	4.52	+ 1.43	.66	10	18	77.0	4, 5	37.0	29	0	2	
IX.	Wetherby (Ribston Hall) ...	4.44	+ 2.10	.94	11	12	...	...	...	...	...	...	
"	Skipton (Arncliffe)	7.12	+ 2.79	1.09	22	22	78.0	5	33.0	31	0	...	
"	Hull (The Park)	3.12	+ .48	.52	10	18	...	...	...	...	...	...	
X.	North Shields	5.73	+ 2.89	2.21	13	17	78.5	4	...	...	...	...	
XI.	Borrowdale (Seathwaite)	9.79	+ 1.34	1.36	15	20	...	...	...	...	...	...	
XI.	Cardiff (Ely)	3.58	— .03	.81	9	18	...	...	...	...	...	...	
"	Haverfordwest	2.95	— .23	.76	9	17	78.6	7	35.0	29	0	3	
"	Plinlimmon (Cwmsymlog) ...	5.57	...	1.00	22	17	...	...	...	...	...	...	
XII.	Llandudno	3.95	+ 1.59	.92	10	19	72.9	4	43.5	30	0	...	
XII.	Cargen [Dumfries]	3.08	+ .09	.74	14	20	73.0	4	33.4	31	0	...	
XIV.	Jedburgh (Sunnyside)	...	...	...	...	...	...	...	...	...	...	...	
XIV.	Old Cumnock	3.45	+ .03	.44	22	19	77.5	7	31.0	30	1	...	
XV.	Lochgilphed (Kilmory)	4.86	+ .30	.75	15	22	...	...	37.0	30	...	...	
"	Oban (Craigvarren)	4.90	...	.94	4	19	70.8	10	41.6	31	0	...	
"	Mull (Quinish)	5.88	+ 1.73	.97	4	20	...	...	...	...	...	...	
XVI.	Loch Leven Sluices	3.00	+ .06	1.00	13	12	...	...	...	...	...	...	
XVII.	Dundee (Eastern Necropolis)	2.65	+ .08	.50	24	16	72.2	5	37.9	31	0	...	
XVII.	Braemar	3.49	+ .16	.95	12	21	70.2	5	31.7	31	1	3	
XVIII.	Aberdeen (Cranford)	3.28	...	.86	15	26	78.0	5	38.0	28d	...	...	
XVIII.	Strome Ferry	6.01	+ 1.34	.91	5	26	72.0	9, 10	39.0	31	0	...	
"	Inverness (Culloden)	3.74	+ 1.74	1.32	27	...	71.0	4, 10	37.0	31	0	1	
XIX.	Dunrobin	3.46	+ 1.06	.87	26	16	70.0	16	42.5	31	0	...	
"	S. Ronaldsay (Roeberry)	2.58	+ .02	.43	15	20	67.0	4	44.0	30c	0	...	
XX.	Cork (Blackrock)	1.92	— 1.40	.40	1	13	76.0	4	40.0	30	0	...	
"	Dromore Castle	4.65	— .33	.60	17	19	70.0	18	42.0	30	0	...	
"	Waterford (Brook Lodge) ...	2.18	— 1.24	.31	9	21	70.0	7	39.0	29	0	...	
XXI.	O'Briensbridge (Ross)	2.97	...	1.02	22	18	78.0	3a	44.0	31	0	...	
XXI.	Carlow (Browne's Hill)	2.70	— .27	.58	22	17	...	...	...	...	...	...	
XXII.	Dublin (Fitz William Square)	2.80	+ .28	.85	22	19	74.8	4	41.5	31	0	0	
XXII.	Ballinasloe	2.86	— .32	.76	22	20	70.0	4b	35.0	31	0	...	
XXIII.	Waringstown	2.53	— .58	.41	10	17	79.0	7	36.0	30	0	2	
"	Londonderry (Creggan Res.) ..	6.48	+ 2.36	1.40	14	25	...	...	...	...	...	...	
"	Omagh (Edenfel)	4.74	+ 1.25	.72	27	20	73.0	8	41.0	29	...	...	

a And 4, 5, 6, 7, 8. b And 7, 8. c And 31. d And 29, 31.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON AUGUST, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LONDON, CAMDEN SQUARE.—*Erratum*.—Min. temp. for July $42^{\circ} \cdot 4$ on 12th, not $45^{\circ} \cdot 1$ on 4th as printed.

STRATHFIELD TURGIS.—A cold uncanny month, savouring much of autumn. With the exception of a few fine summer days from the 3rd to the 6th, the temperature was low with strong winds, and heavy rains. From the 19th the thermometer was but little above 60° . Harvest operations were seriously retarded, and the corn much damaged by the wind and R. The close of the month was very cold and unseasonable, but brighter. The first frost on the grass ($31^{\circ} \cdot 7$) occurred on the 30th. Sharp TS on the 2nd.

ADDINGTON.—A good deal of unsettled weather occurred during the month. The 5th was the only really hot day being the only one on which the temp. in shade rose above 75° . Towards the end of the month the nights were very cold, the min. on grass falling to 31° on 30th. Heavy TS from 4 to 5 p.m. on 2nd and another on 11th.

BURY ST. EDMUNDS, WESTLEY.—The month was a cold one, the 1st and 5th being the only hot days. A very heavy R of $1 \cdot 15$ in. fell on the 10th, with distant T. Although R fell on 13 days, the quantities were small, and being accompanied by drying winds, most of the corn was harvested in good condition.

LANGTON HERRING.—This month like the preceeding two months was wet and cold. The mean temp. at 9 a.m. being $2^{\circ} \cdot 2$ below the average. The long continuance of wind from W. S.W. was noticeable. T and L on 9th, 18th and 27th.

BODMIN, FORE STREET.—On the 9th, between 9.30 and 10.30 p.m., a storm of incessant L, loud T, and a downpour of R occurred. A very cold month for August, with many rainy days. Splendid weather during the last four days. Sharp frost on the morning of 30th.

STROUD, UPFIELD.—TS at 4 a.m. on the 10th; three or four vivid flashes of L, and a tree struck. Slight T at 9 a.m. on 16th.

WOOLSTASTON.—Another cold and sunless month, with frequent R; very prejudicial to the corn harvest. T and L on 1st and 15th. Mean temp. $56^{\circ} \cdot 7$.

ORLETON.—The first half of the month was very warm and pleasant, but the remainder was cold with much R, the mean temperature being nearly 1° lower than the average, though rather above that of August, 1889. Very heavy storms of R in the early mornings of 16th and 23rd. T on 16th and 27th.

BARKBY.—T on 11th, 16th, 20th, 24th, 26th, 27th and 28th. H on the 24th. Mean temp. $59^{\circ} \cdot 1$.

MANCHESTER, PLYMOUTH GROVE.—Summer weather prevailed on the first nine days, and on the 18th; the remainder of the month was changeable and unsettled, and very showery and cold. T on 24th and 29th. T and L on 26th. Mean temp. $58^{\circ} \cdot 1$.

HULL, PEARSON PARK.—The weather during the month was generally wet, especially so during the middle and latter part, but a period of fine bright weather occurred from the 3rd to the 9th.

N. SHIELDS.—T on 13th.

SEATHWAITE.—T, L and H on 25th.

WALES.

HAVERFORDWEST.—A considerable improvement took place in the weather as regards sunshine, warmth and moisture at the beginning of the month, which continued up to the 11th; the weather then relapsed into a stormy, wet and unsettled condition, with a rather low temp. for August. During the last week the temp. was much below the average, and it was generally wet except

the last three days, which were fine and cold, with bright sunshine and high wind. Mean temp. $55^{\circ} \cdot 9$, $2^{\circ} \cdot 8$ below the average of 10 years. Prevailing winds W.S.W. and N.N.W., the latter predominant. Crops looking well, and harvest prospects favourable except potatoes, which are bad. B though frequent, not disastrous. Temp. reached 70° only four times.

SCOTLAND.

CARGEN.—Mean temp. of the month $55^{\circ} \cdot 9$, $2^{\circ} \cdot 5$ below the average. The first twelve days were very fine, the mean temp. for the period being $61^{\circ} \cdot 1$. For the last 19 days the mean temp. was only $52^{\circ} \cdot 7$, remarkably low for August. The nights of the last week were very cold, and on the 31st the thermometer fell to $33^{\circ} \cdot 4$, the lowest in August since 1869, when $32^{\circ} \cdot 4$ was recorded. Harvest operations were much interfered with, and the constant wet and low temp. greatly injured potatoes, which are much diseased. T on 29th; H on 26th and 29th.

OBAN.—The continuance of heavy B since May last has not been interrupted, and temp. remained low throughout the month. The crops are very backward, and in many places potatoes are showing disease. The hay is seriously damaged, but much is still uncut, awaiting a fair autumn.

CULLODEN.—The month was cold and wet, and very deficient in sunshine. Crops promising, but late.

IRELAND.

CORK.—A cold and unseasonable month, with much damp and sunless weather. Mean temp. $59^{\circ} \cdot 2$, $2^{\circ} \cdot 3$ below the average of 14 years.

DROMORE.—Weather very unsettled. Crops not up to the average. Potatoes very poor, owing to blight. Turf scarce, as owing to the continuous B it is difficult to get it dry, consequently great fears are entertained in this part as to the fires for winter.

WATERFORD, BROOK LODGE.—All the early part of the month was very broken weather, but after the 27th the weather was most favourable for harvest work. Mean temp. $57^{\circ} \cdot 0$.

O'BRIENSBRIDGE, ROSS.—The month began with a fine week, and closed with two very fine and warm days; nearly all the rest was rainy or misty, and as a result unfavourable to harvesting.

DUBLIN.—Except for a fine warm period, extending from the 2nd to the 5th inclusive, and for a few isolated fine but cold days afterwards, the month proved showery, cold and squally. Prevailing wind N.W., temp. $2^{\circ} \cdot 5$ below the average. High winds prevailed on 11 days, and attained the force of a gale on 15th and 22nd. Fog on 1st, L on 15th, TS with H on 26th. Temp. reached 70° in screen on two days. H fell on 23rd.

WARINGSTOWN.—The B of this month was less than the average of 28 years, and that of July was the same, which will surprise those who are crying out about excessive B. Very little potato disease in this district, except in gardens, and in the early varieties which are well-known always to be liable to its ravages. 30th and 31st, two remarkably cold nights for the season.

OMAGH, EDENFEL.—The month seemed to commence in settled summer weather, and for the first and only occasions during the year temperatures of 70° and upwards were twice registered during the first week. The second week was wet and unsettled, the third somewhat better, but from the 20th to the end a period of persistent and heavy B (amounting in the eleven days to $3 \cdot 2$ in.) followed, accompanied by low temperatures doing much, but not irretrievable, damage to all crops, especially potatoes. A peculiarity of the bad weather of this summer has been that much of it has been accompanied by a high and steady barometer.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCVII.]

OCTOBER, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE AUTUMN CONGRESSES.

(Continued from p. 120.)

THE BRITISH ASSOCIATION.

Whether, or not, the need for this organization is decreasing, we do not know. Probably it, like other bodies, must adapt itself to changed circumstances, and there was much evidence, at Leeds, of a desire to do so. Moreover, the scheme for the affiliation of Local Societies is solidifying, and it will undoubtedly greatly strengthen the parent, while benefiting the Corresponding societies. It is not for us to point out here the modifications in the Association which may be expedient; we have to deal only with Meteorology, but as regards it to mention, that we have heard several remarks as to the scant recognition afforded to that subject. The words Meteorology, Electricity, Magnetism, and Astronomy do not occur in the B. A. programme, all these subjects are included in Section A—Mathematics and Physics—while Chemistry, Geology, Biology, Geography, Statistics, Engineering, and Anthropology, has each a section to itself. For nearly half a century, no Meteorologist has been President of Section A, or of the Association. Hence, naturally meteorologists do not rally at the meetings, and papers get yearly more scarce. This year, Mr. Hopkinson tried, by sending in four papers, to galvanize the section, but with a Sectional Committee of 54 members, of whom not more than seven ever worked at meteorology, a strong shock is needed, and the audience, when the papers were read, was not encouragingly numerous.

We now proceed to notice the communications:—

W. J. E. BINNIE.—*On the Size of Drops Falling from a Tube.*

Mr. Binnie has designed an inexpensive form of recording rain-gauge; in it the uniformity of the size of drops is essential; this led him to researches, the result of which is given in his paper.

C. CHAMBERS, F.R.S.—*On Ferrel's Theory of the Winds.*

A very mathematical paper criticizing a review by Mr. H. F. Blanford, F.R.S., of Prof. Ferrel's last work.

DR. BUCHAN.—*Report of the Committee on the Ben Nevis Observatory.*

During the past year, observations had been made continuously at the top of Ben Nevis, and at the sea-level, at Fort William. Mr. Omond had completed an important investigation of the temperature of Ben Nevis, and of the wind force, and Mr. Rankin had photographed clouds, and other meteorological phenomena. In the autumn of last year a grant of £50 was obtained from the Government for carrying on an investigation into the number of dust particles in the atmosphere. Messrs. Omond and Rankin were still engaged with the enquiry into the direction of the winds observed at the top, and at the low level stations at the same hours, and in studying their relation to the weather of North-Western Europe. The comparative frequency with which the winds at the Observatory blow not with, but against, the isobars of low level stations and indicated a force widely different from the barometric gradients of the weather maps of the Meteorological Office, were striking elements in the meteorology of Ben Nevis. At Fort William the mean temperature was $0^{\circ}8$ under the average, the greatest defect from the mean being $1^{\circ}8$ in February, and the greatest excess $5^{\circ}6$ in May. The outstanding feature of the meteorology of the year was the all but unprecedentedly high temperature of May, a temperature, as regarded Scotland, only once exceeded since 1764. At the top of the Ben the excess above the mean was greater, amounting to $7^{\circ}7$, as happened during all unusually high summer temperatures. The minimum temperature on Ben Nevis was $6^{\circ}4$, which occurred at 7 a.m. of February 10th. This was absolutely the lowest temperature which had been recorded since the opening of the Observatory in December, 1883. The maximum was $61^{\circ}8$ on July 4th. Thus the extreme range of temperature for the past year was $55^{\circ}4$. The registrations of the sunshine recorded showed 634 hours of sunshine, as against 970 hours of the previous year, the latter year thus showing a half more hours. The largest number, 213, was recorded in June; the smallest, 9, in August, being the lowest that had occurred, hitherto, in any summer month. As the highest possible hours for the whole was 4,470, sunshine prevailed on the top of the Ben, in 1889, during only one hour in seven. The amount of the rainfall during the past year was 120·66 in., being about 10 in. less than the average, the least rainfall being 1·94 in. in June, and the greatest 18·04 in. in December, and 17·69 in. in January. The importance of the investigations conducted at Ben Nevis in their relation to cyclones and anti-cyclones was touched upon, and in future meteorological data will be obtained with a view to better forecasts of the weather. They recommended that the committee be re-appointed, Lord McLaren being chairman, in place of Mr. Abercrombie, whose health compelled him to live abroad, and a grant of £150 will be proposed. [Only £50 was granted by the General Committee.]

DR. MILL.—*Report of the Committee for Determining the Seasonal Variation in the Temperature of the Lakes, Rivers, and Estuaries.*

G. J. SYMONS, F.R.S.—*Report of the Committee on Solar Radiations.*

An interim report, stating that the work of the Committee had been seriously interrupted by the death of Prof. Balfour Stewart, F.R.S., and by Prof. Schuster's engagements preventing his taking it up. The whole of the apparatus and correspondence had been found, and Prof. M'Leod, F.R.S., had consented to join the Committee, and make experiments with the apparatus designed by Prof. Balfour Stewart, and constructed by Mr. Casella.

A. L. ROTCH.—*On a Meteorological Observatory recently established on Mont Blanc.*

Mr. Rotch, who has lately visited M. Vallot's observatory, and who handed round photographs of it, said, that until recently, the highest meteorological station in the world was in the United States, on Pike's Peak, at an elevation of 14,134ft. above the sea, and the highest station in Europe was on the Sonnblick, in the Austrian Alps (10,170ft.). The French, who had done so much for high-level meteorology, could now claim the highest station in the world, M. Vallot having established a cabin, provided with many registering instruments at the Rocher des Bosses, 1,460ft. below the summit of Mont. Blanc, or 14,320ft. above the sea. It was hoped to maintain the instruments—which had to be attended to once in 15 days—in action during four months of the year. A series of intermediate stations was projected. Some idea of the difficulty and cost of M. Vallot's undertaking would be afforded by mentioning that the wooden observatory cost in the valley £32, but it made 120 loads for the porters, and by the time it was erected at 14,320ft. it had cost quite £400. Mr. G. J. Symons alluded to the expense of keeping up mountain observatories, where two or three attendants had to be located, and said that he was inclined to think that self-recording instruments would be successful, and if so, the cost would be greatly reduced. If they could be made to go for 15 days, they could be made to go for 31 days; indeed, it was difficult to say where the limit would be. He did not believe that tenths of degrees would be accurately recorded by such instruments, but tenths of degrees were not always of much consequence. In reply to a question, Mr. Rotch said that on account of the cost, the observatory on Pike's Peak had been abandoned.

J. HOPKINSON.—*On the Climate of Scarborough compared with that of some other Sea-side Health Resorts.*

After giving reasons for inferring that meteorological observations taken continuously during the decade 1880–89 may advantageously be utilised to deduce the most important elements of the climate of any place in the British Isles, the author showed that observations taken at Scarborough during this period fulfilled the necessary requirements as to accuracy and continuity, and also as to

uniformity with those taken at other places with which he compared the principal results.

A table, showing the monthly and annual means of temperature (mean, mean min., mean max., and mean daily range), relative humidity, cloud, and rainfall; and the extremes of temperature, at Scarborough, for this decade, was given, and the general results of comparison with the climate of four other seaside health-resorts, situated in succession at nearly equal distances round the English coast, was summarised thus :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	RAIN FALL.
	MEANS.				EXTREMES.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
Scarborough	47.5	42.6	52.5	9.9	10.5	83.8	83	6.6	ins.
Lowestoft	48.2	42.4	53.9	11.5	9.2	87.0	83	6.8	24.15
Worthing	49.5	43.7	55.3	11.6	13.5	83.3	83	5.9	26.55
Babbacombe	49.9	44.0	55.9	11.9	15.6	85.6	82	7.0	33.58
Llandudno	49.2	44.1	54.3	10.2	14.5	84.0	79	6.9	29.13
Mean	48.9	43.4	54.4	11.0	12.7	84.8	82	6.6	28.33

These figures show that Scarborough is 3 per cent. colder than the mean of the five places, has 2 per cent. less mean daily range of temperature (computed as a percentage of the mean temperature), is 1 per cent. more humid, and has the mean amount of cloud and rainfall.

J. HOPKINSON.—*A Comparison of the Climate of Halifax, Bradford, Leeds, Wakefield, and Hull.*

Having shown that meteorological observations had been taken at these five manufacturing towns in the South of Yorkshire during the decade 1880-89 with sufficient uniformity and continuity for a satisfactory comparison to be made, the author gave the principal results for this purpose in the following table :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	RAIN- FALL.
	MEANS.				EXTREMES.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
Halifax	46.5	39.6	53.4	13.8	10.0	89.0	%	0-10	ins.
Wakefield	47.7	41.0	54.4	13.4	11.5	86.8	84	7.3	28.01
Bradford.....	48.0	42.4	53.7	11.3	12.0	84.4	79	7.2	30.15
Leeds	48.8	42.6	55.1	12.5	12.0	87.0	81	6.7	25.53
Hull	47.1	39.9	54.3	14.4	6.0	85.0	81	6.3	27.07
Mean	47.6	41.1	54.2	13.1	10.3	86.4	82	6.9	29.46

In order to render more perspicuous the relation which the above values bear to the mean and to each other, the deviations per cent. from the mean were deduced (all the deviations in temperature being computed as percentages of the mean temperature), with the following result :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	RAIN- FALL.
	MEANS.				EXTREMES.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
	%	%	%	%	%	%	%	%	%
Halifax	- 2	- 3	- 2	+ 1	- 1	+ 5	+ 2	+ 2	+ 24
Wakefield	=	=	+ 1	+ 1	+ 2	+ 1	+ 3	+ 6	- 5
Bradford.....	+ 1	+ 3	- 1	- 4	+ 4	- 4	- 3	+ 4	+ 2
Leeds	+ 2	+ 3	+ 2	- 1	+ 4	+ 1	- 1	- 3	- 13
Hull	- 1	- 3	=	+ 3	- 9	- 3	- 1	- 9	- 8

J. HOPKINSON.—*The Inland compared with the Maritime Climate of England and Wales.*

The author first endeavoured to show that the chief difficulties in making a satisfactory comparison between our inland and our maritime climate would be removed if a sufficient number of meteorological stations could be found which represent approximately the mean height and the range of the land in the interior and near the coast, and if the mean position of the inland and the maritime places were almost identical and not far distant from the centre of England. From the "Meteorological Record" of the Royal Meteorological Society he selected, as approximately fulfilling these conditions, Buxton, Woburn (Aspley Guise), Croydon (Addiscombe), Cheltenham, and Churchstoke, to represent the interior of the country; and Scarborough, Lowestoft, Worthing, Babbacombe, and Llandudno, to represent the sea-coast. The mean height above the sea of the meteorological stations at the five inland places is 469 feet, and the mean height of those at the five maritime places is 124 feet, the range in the former being from 184 to 987 feet, and in the latter from 21 to 293 feet. The mean latitude of the five inland places is $52^{\circ} 12' N.$, the mean longitude $1^{\circ} 32' W.$; the mean latitude of the five maritime places is $52^{\circ} 22' N.$, the mean longitude $1^{\circ} 16' W.$ The mean position indicated is in each case near the centre of England (a little south of Birmingham).

The values for the decade 1880-89 for the chief elements of the climate of the five places situated on the coast having already been given in the author's paper on "The Climate of Scarborough," those for the five places situated in the interior are given in the following

table, with the means, and, for easy comparison, the means for the sea-side places and for the whole : —

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	RAIN- FALL.
	MEANS.				EXTREMES.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
Buxton	44·6	37·6	51·6	14·0	-4·0	82·1	85	0-10	ins.
Woburn	47·6	40·4	54·8	14·6	-1·0	86·1	83	7·5	32·06
Croydon	48·8	41·9	55·8	13·9	11·6	92·4	80	7·4	25·56
Cheltenham	47·9	40·4	55·4	15·0	-3·3	87·8	83	7·0	28·86
Churchstoke	46·7	40·4	54·8	14·4	6·9	90·7	83	6·9	24·46
Mean { Inland ...	47·1	39·9	54·3	14·4	2·0	87·8	83	7·2	31·81
	Maritime.	48·9	43·4	54·4	11·0	12·7	84·8	82	6·6	28·33
Mean of all.....	48·0	41·7	54·4	12·7	7·4	86·3	82·5	6·9	30·07

The conclusion to be drawn from this table was, he considered, that in every respect, as far as concerns our comfort and most probably also our health, our maritime climate is on the whole superior to our inland climate, being warmer, owing (it is most important to observe) to the nights not being nearly so cold while the days are no hotter, the extremes of temperature being much less, the air rather less humid, the sky less cloudy, and the rainfall less.

Discussion having been invited,

Mr. Symons said that Mr. Hopkinson's papers were very interesting, and that some day corporations and other representative bodies would perhaps think that climate had something to do with the health of the people, and that it was desirable that accurate meteorological observations should go along with statistics of population. Leeds was no greater sinner in this respect than other towns, but it had not one single well-equipped meteorological observatory. There ought to be one or two places in Leeds, and one on Woodhouse Moor. He ventured to think that, as regarded the West Riding towns, many differences brought forward by Mr. Hopkinson were due to the position of the instruments among chimnies, &c., rather than differences in the five manufacturing towns themselves which were compared with Leeds. He also took exception to the new method of expressing temperature differences as percentages.

Mr. Hopkinson said that Mr. Symons' objections could only apply to the five manufacturing towns; for the other papers read, the results could be relied upon as accurate meteorological statistics. He quite agreed that it would be well to start an observatory in the neighbourhood of Leeds; and all that it would be necessary to do would be for some one to take an observation at nine o'clock

in the morning and forward it to the Royal Meteorological Society, where all the results would be worked out.

The President (Dr. Glaisher) advised Mr. Hopkinson to take other five places at the seaside and five other inland places to make another comparison, because he was rather struck with the result already obtained, viz., that the climate at the sea-coast was better than that inland; and for his own part he thought that it might have been brought about in Mr. Hopkinson's comparison by a sort of give-and-take arrangement, and was not a thing really definitely settled.

J. HOPKINSON, F.R.Met.Soc.—*On Meteorological Photography.*

The author called attention to the increasing importance attached to photography, as a means of illustrating scientific subjects, and aiding scientific research. In no science, he thought, could photography be of greater value than in meteorology, owing to the transient nature of meteorological phenomena.

The appointment of a Committee of the British Association on Meteorological Photography, by which Committee instructions to photographers would be issued with the view of instituting a systematic method of working, &c., would, he felt sure, greatly extend the interest taken in the subject and increase the scientific value of the results. The chief object of such a committee would be to investigate and report upon the means by which photography can most advantageously be applied to the elucidation of meteorological phenomena, such as the forms of clouds and of lightning flashes, and the effects of storms. The Committee would also undertake the collection of photographs of such phenomena and keep a register of them, reporting the additions made each year, and would compile a bibliography of the subject.

In the study of the various forms of clouds the author believed that a satisfactory classification could best be made by the comparison of numerous photographs; the relation between cloud-forms and atmospheric pressure and temperature would be an interesting field for research; and an attempt might be made to ascertain the best means of overcoming the difficulty of photographing light clouds on a blue sky, owing to the blue rays being almost as powerfully actinic as white.

In the investigation of lightning by photography, special attention would be given to the appearance on the plates of so-called dark flashes, with the object of arriving at a conclusive explanation of the phenomenon; and an endeavour might be made to determine whether lightning really forms a streak or a point in excessively rapid motion.

The collection and exhibition of photographs showing the destructive effects of storms, whether the destruction or damage were wrought by rain, by wind, or by lightning, might not be considered of such scientific importance as the investigation of clouds and

lightning, but it would add much to the general interest of the enquiry.

Mr. Symons observed that they would make their section much more attractive if they exhibited photographs of meteorological phenomena, for many people thought that the study of meteorology consisted solely in the calculation of tables of figures, whereas their science was most interesting.

The President (Dr. Glaisher) said that the Committee of the Section had that morning approved of Mr. Hopkinson's proposal, and asked the Committee of Recommendations to appoint a Committee on Meteorological Photography. [This was subsequently approved by the General Committee.]

FRIESE GREENE.—*Exhibition of Photographs of Clouds.*

No paper was read respecting these large and fine photographs, but the President stated that on one of them there were four clouds shown which were not visible to the naked eye ; this result had been obtained by taking the negative through yellow glass.

G. J. SYMONS.—*On the arrangements for recording Phenological Phenomena.*

This was a short paper read in the Biological Section in order to bring to the knowledge of naturalists the important work done in this subject under the auspices of the Royal Meteorological Society, and to draw attention to the simplified form now issued. Instead of occupying space with the paper, we appropriate it to advising our readers to apply for a specimen of the form to E. Mawley, Esq., F.R.Met.Soc., Rosebank, Berkhemsted, Herts, and if possible to help him in the work which he is doing for the society.

"FATHER PERRY" MEMORIAL.

THAT which men will not do for the living, they frequently will do in honour of the dead who cannot profit thereby. Our opinion of Father Perry and of his work has already been given (Met. Mag. Vol. xxiv. p. 183), such a character needs no praise, and no memorial, but when one is proposed, it becomes an insult rather than an honour if it is not supported.

A very strong committee is trying to collect £2,700, wherewith to present a 15-inch equatorial to Stonyhurst, where Perry would have used one so well. We do not allow ourselves to doubt that the amount will be raised, but all who would share in the good work should send direct to the treasurer, A. C. Thomas, Esq., Marlton Chambers, 30, North John-street, Liverpool.

HEAVY HOURLY RAINFALL ON BEN NEVIS.

To the Editor of the Meteorological Magazine.

SIR,—I enclose the hourly rainfall on Ben Nevis for the 25th, 26th, and 27th of September. You will see that the torrential down-pour which did so much damage in the vicinity of Fort William, commenced at 6 p.m. of the 25th, and lasted till noon of the next day, the rainfall for these eighteen hours being 6·264 in., of which 4·514 in. fell in the 8 hours ending 5 a.m. of the 26th.

Yours very truly,

R. C. MOSSMAN.

10, Blacket Place, Edinburgh, Oct. 2nd, 1890.

September 25th.		September 26th.		September 27th.	
Hours ending.	Amount.	Hours ending.	Amount.	Hours ending.	Amount.
1	·022	1	·808	1	·100
2	·009	2	·750	2	·144
3	·042	3	·511	3	·147
4	·009	4	·369	4	·203
5	·008	5	·619	5	·108
6	·004	6	·218	6	·116
7	·036	7	·205	7	·220
8	·040	8	·160	8	·196
9	·018	9	·140	9	·168
10	·008	10	·168	10	·160
11	·028	11	·182	11	·164
Noon	·015	Noon	·154	Noon	·170
13	·013	13	·050	13	·180
14	—	14	·025	14	·150
15	·014	15	·010	15	·071
16	·008	16	·006	16	·151
17	·012	17	·005	17	·151
18	·025	18	—	18	·048
19	·227	19	—	19	·078
20	·113	20	·032	20	·024
21	·183	21	·076	21	·025
22	·269	22	·049	22	·042
23	·402	23	·083	23	·055
Midnight	·786	Midnight	·074	Midnight	·040
Sums	2·291	Sums	4·694	Sums	2·911

[This gives for the rainfall day of 25th 5·88 in., and of 26th 2·32 in., but, for the newspapers, the Ben Nevis day seems to end at 9 p.m., and that gave 5·95 in. for 26th, and 2·57 in. for 27th. All these values are, however, surpassed by the record (up to 9 p.m.) for Oct. 3rd, which was 8·07 in.—Ed.]

FURTHER REMARKS ON THE DISCUSSION CONCERNING
BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—I had not intended to intervene again in this discussion, but I am induced, by some remarks in this Magazine for September, 1890, pp. 121 and 122, to ask your permission to offer a few further observations by way of explanation.

The supposition that the greater fluctuations of atmospheric pressure are the result of the outflow of currents of highly heated air from the equatorial regions, so far from having been put forward by me "as new and altogether the better for being new," was avowedly a reproduction, with some modifications, of the view held by the late Sir John Herschel, and elaborated by him in considerable detail in his latest utterance on the subject (*Familiar Lectures on Scientific Subjects*, article, "Weather"). It was impossible to pursue the subject in detail without trespassing too far upon your space, but as my critic seems to suppose that I was writing at random and in ignorance of elementary facts, which, if I had been acquainted with them, would have prevented me from writing such unmitigated nonsense, as it seemed to him, I may now add that the powerful upward movement of the heated currents would account for the absence of any increase of pressure over the regions traversed by them in the earlier part of their course, while the fact that they were moving polewards over converging meridians would explain—(1) the greater frequency and intensity of the barometric fluctuations experienced in the temperate as compared with the tropical zones; (2) the tendency of two or more anti-cyclonic areas to coalesce; and (3) the piling up of the air in the form of huge anti-cyclones in high latitudes. Such an anti-cyclone as that which prevailed over Western Europe about the middle of last November might well have been caused in this way; it could hardly have been occasioned by cold, as temperature was quite exceptionally high at the time. I am aware that, according to the orthodox view, the influence of these equatorial currents does not extend beyond 30° or thereabouts on either side of the equator. But it is highly improbable that there should be any such uniform limit to their range. Such a supposition would involve the incredible assumption that the effective heating power of the sun is as great over water as over land, and no greater over a treeless and arid region, such as the Sahara, than over a relatively cool and moist region, like that covered by the great equatorial forest described by Stanley in "Darkest Africa." But, independently of any such *à priori* grounds, we have plenty of positive evidence, as, for instance, in the behaviour of the Krakatoa dust, to show that the overlapping upper currents extend much farther northward and southward of the equator than is commonly supposed.

My critic says that he has "roughly reviewed" this discussion. Yes! very roughly, as far, at any rate, as Dr. Muirhead and myself

are concerned. Dr. Muirhead graphically, but not too forcibly, indicated the tone and tenour of his first letter when he described him as "knocking together the heads of two ignorant scribblers and sending them to learn their lessons" (*Met. Mag.*, July, 1890, p. 88). In his latest communication he refers to us, by implication, as meteorological quacks who, by our foolish meddling with matters that are too high for us, deter better qualified men from the study of meteorological problems. I venture to think that the peculiar style of controversy adopted by our critic, and the *de haut en bas* attitude which he thinks it fitting to assume towards fellow-seekers after the truth are much more likely to "lend a deterrent aspect to a most interesting branch of science."

I entered upon this discussion with the hope that, through the courtesy of some of your readers, who had been able to devote more time and study to the consideration of meteorological problems than myself, I should obtain much valuable information upon the subject to which I had invited attention. I leave it with the conviction, forcibly impressed upon my mind by the course which the discussion has taken, that no satisfactory theory of the origin of a depression system has as yet been formulated, and that, in the existing state of our knowledge, the really wise men are the Abercrombys who, when asked their opinion upon the subject, shake their heads and confess that they do not know.

G. T. RYVES.

Team Vicarage, October 1, 1890.

SUNBURN.

To the Editor of the Meteorological Magazine.

SIR,—I hope that the interesting question you raised at the beginning of your number for September, 1890, in the notice of Dr. Bowles's "Sunburn on the Alps," as to the cause of sunburn, will elicit a more satisfactory explanation than has been, so far, given.

Professor Tyndall's experience of having been more burnt at the North Foreland than on Alpine snows is borne out by the well-known browning or bronzing of sailors and boatmen who are much exposed on the sea. My own experience on land, in Britain and in India, from sea-level to a height of 10,000 feet and upwards, is that I have felt more burnt by the sun under light clouds and mist than under a cloudless sky. This may be partly due to the fact that one exposes oneself more freely, and protects one's skin less, during cloudy weather than in bright sunshine.

I am inclined to believe that the suffusion of the air with sunlight by means of reflection from all bright surfaces, and by refraction at the same time, has much to do with the phenomenon of sunburn.

Yours truly,

B. R. BRANFILL.

Billericay, October 1, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MARCH, 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
°		°		°	°	°	0-100	°	°	inches		0-10	
England, London	66·2	28	15·6	4	51·1	36·5	38·1	80	103·7	12·8	1·76	14	6·9
Malta.....	72·2	31	40·2	3	62·8	50·4	48·0	77	129·7	34·0	1·02	8	4·5
<i>Cape of Good Hope</i> ...	96·8	18	47·2	2	77·7	57·6	...	...	...	...	·19	...	2·2
<i>Mauritius</i>	83·5	25	70·4	3	81·2	73·2	71·5	85	136·0	65·2	11·36	25	7·6
Calcutta.....	100·8	29	62·8	1	91·5	71·1	69·3	70	152·6	54·6	·33	6	3·0
Bombay.....	89·4	19a	71·8	6	85·8	74·3	69·5	71	140·0	60·9	·00	0	2·1
Ceylon, Colombo	90·5	29	71·8	4, 5	88·2	75·0	71·9	76	147·0	67·0	5·34	22	5·2
<i>Melbourne</i>	94·6	5, 16	49·0	1, 2	77·3	58·0	56·0	70	148·1	38·1	1·62	10	6·1
<i>Adelaide</i>	97·7	15	49·8	28	81·9	60·4	52·5	51	159·9	42·5	·58	3	2·7
<i>Wellington</i>	76·8	2	43·0	30	68·0	52·4	50·1	69	139·0	34·0	2·23	13	4·2
<i>Auckland</i>	78·0	3	46·0	25	72·7	57·5	54·0	68	140·0	42·0	...	...	4·7
Jamaica, Kingston.....	89·3	24	61·4	14	85·5	66·8	66·3	75	...	...	3·27	...	...
Trinidad	89·0	9ab	62·0	15	86·2	68·8	67·2	75	158·0	62·0	2·09	13	...
Toronto	53·5	25	—2·7	6	34·7	20·9	23·2	77	...	—7·1	1·48	20	6·0
New Brunswick, Fredericton	48·8	12	—11·2	...	36·2	18·5	22·6	68	...	...	4·39	16	6·6
Manitoba, Winnipeg ...	38·0	10	—32·2	4	19·6	— 5·5	9·3	91	...	...	1·54	14	3·7
British Columbia, Victoria	54·0	19	29·0	5	47·7	37·0	...	...	...	...	1·50	16	...

a And 24. b And 27.

MARCH REMARKS.

MALTA.—Mean temp. 55°·5; mean hourly velocity of wind 12·7 miles. Sea temp. rose from 59°·8 to 62°·3. J. SCOLES.

Mauritius.—Mean temp. of air 1°·2 below, of dew point 1°·7 above, and R 3·37 in. above, their respective averages. Mean hourly velocity of wind 7·1 miles, or 3·0 below the average; extremes 20·0 on 1st, and 0·0 on 20th; prevailing direction E. by N. to S.E. by E. T and L on nine days; T on two days, and L on five days.

C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on fifteen days, and L was seen on six other days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 3°·0, of dew point 4°·0, humidity 2, amount of cloud 0·5 above, and R 44 in. below, their respective averages. Prevailing winds S.E. and S. Strong on seven days. Heavy dew on four days. TSS on four days.

R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. 0°·8 above the average. R about half an inch below the average. C. TODD, F.R.S.

Wellington.—The early part of the month was generally fine with occasional showers, the latter part showery. Prevailing winds N.W. and S.E., strong from N.W. on six days. Mean temp. 1°·9 below the average. R 59 in. below the average.

R. B. GORE.

Auckland.—The early and middle parts of the month were fine and dry; much cooler with frequent showers at the close. Mean temp. and R both close to the average; bar. pressure much above it. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 SEPTEMBER, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain
		in			in.
II.	Dorking, Abinger Hall.	1·08	XI.	Castle Malgwyn	2·26
"	Margate, Birchington...	·75	"	Builth(Llanwrtyd Wells)	2·29
"	Littlehampton	·95	"	Rhayader, Nantgwillt..	2·50
"	Hailsham	1·24	"	Carno, Tybrith	1·85
"	Ryde, Thornbrough	·74	"	Corwen, Rhug	1·17
"	Alton, Ashdell.....	·86	"	I. of Man, Douglas	4·12
III.	Oxford, Magdalen Col...	1·02	XII.	Stoneykirk, Ardwell Ho.	2·53
"	Banbury, Bloxham	1·39	"	New Galloway, Glenlee	4·37
"	Northampton	·76	"	Melrose, Abbey Gate ...	1·44
"	Cambridge, Fulbourne..	·24	XIII.	N. Esk Res. [Penicuik]	4·85
"	Wisbech, Bank House..	·39	XIV.	Ballantrae, Glendrishaig	5·35
IV.	Southend	·76	"	Glasgow, Queen's Park.	3·50
"	Harlow, Sheering	·39	XV.	Islay, Gruinart School..	6·76
"	Rendlesham Hall	·97	XVI.	Dollar.....	4·02
"	Diss	1·00	"	Balquhider, Stronvar..	7·35
"	Swaffham	·58	"	Coupar Angus Station..	2·98
V.	Salisbury, Alderbury ...	1·61	"	Dunkeld, Inver Braan..	3·39
"	Warminster	1·47	"	Dalnaspidal H.R.S. ...	4·01
"	Bishop's Cannings	1·91	XVII.	Keith H.R.S.	2·17
"	Ashburton, Holne Vic...	2·01	"	Forres H.R.S.	1·40
"	Hatherleigh, Winsford.	·79	XVIII.	Fearn, Lower Pitkerrie.	2·01
"	Lynmouth, Glenthorne.	·99	"	Loch Shiel, Glenaladale	11·36
"	Probus, Lamellyn	2·45	"	N. Uist. Loch Maddy ...	3·45
"	Launceston, S. Petherwin	2·95	"	Invergarry	3·60
"	Wincanton, Stowell Rec.	1·99	"	Aviemore H.R.S.	1·77
"	Taunton, Lydeard Ho...	...	"	Loch Ness, Drumnadrochit	1·74
"	Wells, Westbury	1·55	XIX.	Lairg H.R.S.	3·19
VI.	Bristol, Clifton	1·43	"	Scourie	2·47
"	Ross	1·62	"	Watten H.R.S.	2·58
"	Wem, Clive Vicarage ...	·88	XX.	Dunmanway, Coolkelure	3·77
"	Cheadle, The Heath Ho.	·75	"	Fermoy, Gas Works ...	2·77
"	Worcester, Diglis Lock	·81	"	Tipperary, Henry Street	2·09
"	Coventry, Coundon	1·30	"	Limerick, Kilcornan ...	2·48
VII.	Ketton Hall [Stamford]	·68	"	Miltown Malbay.....	4·64
"	Grantham, Stainby	·87	XXI.	Gorey, Courtown House	2·10
"	Horncastle, Bucknall ...	·65	"	Navan, Balrath	1·99
"	Worksop, Hodsok Priory	1·21	"	Mullingar, Belvedere ...	3·91
VIII.	Neston, Hinderton	1·11	"	Athlone, Twyford	3·00
"	Knutsford, Heathside ...	·98	"	Longford, Currygrane...	3·34
"	Lancaster, South Road.	3·96	XXII.	Galway, Queen's Coll...	2·70
"	Broughton-in-Furness ..	6·61	"	Clifden, Kylemore	9·20
IX.	Wakefield Prison	1·46	"	Crossmolina, Enniscoe..	3·03
"	Ripon, Mickley	2·12	"	Collooney, Markree Obs.	3·65
"	Scarborough, West Bank	1·57	"	Ballinamore, Lawderdale	3·64
"	East Layton [Darlington]	1·69	XXIII.	Warrenpoint	2·27
"	Middleton, Middleton ..	1·81	"	Seaforde	2·19
X.	Haltwhistle, Unthank..	2·46	"	Belfast, New Barnsley..	4·25
"	Shap, Copy Hill	...	"	Bushmills, Dundarave...	3·56
XI.	Llanfrehfa Grange	1·66	"	Stewartstown	3·34
"	Llandovery	2·36	"	Bunorana	4·98

SEPTEMBER, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				No. of Days in which it was above the average.	
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Max.		Min.					
				Dpth.	Date.				Deg.	Date	Deg.		Date
I.	ENGLAND.	London (Camden Square) ...	.65	- 1.86	.26	17	5	75.9	10	37.8	1	0	0
II.		Maidstone (Hunton Court)...	.98	- 1.61	.36	17	6	...	...	...	...	...	...
III.		Strathfield Turgiss	.75	- 1.70	.33	21	9	75.8	10	32.5	1	0	1
III.		Hitchin	.26	- 2.24	.08	17	6	72.0	5	47.0	12	0	0
IV.		Winslow (Addington)	1.15	- 1.52	.65	22	11	76.0	27	34.0	1	0	1
IV.		Bury St. Edmunds (Westley) ..	.63	- 2.07	.19	20	7	...	...	...	...	...	...
V.		Norwich (Cossey)	.93	- 1.73	.32	21	7	73.0	10a	35.0	1	0	...
V.		Weymouth (Langton Herring) ..	1.41	- 1.01	.41	17	8	75.0	6	44.0	1	0	...
"		Barnstaple	1.64	- 1.85	.41	17	10	73.0	9	37.5	1	0	...
"		Bodmin (Fore Street)	2.28	- 2.19	1.18	17	14	...	...	...	...	...	...
VI.	Stroud (Upfield)	1.03	- 1.88	.32	17	8	74.0	6, 8b	47.0	21d	0	...	
"	Churchstretton (Woolstaston) ..	.78	- 1.72	.23	17	10	74.5	9	43.0	1	0	...	
"	Tenbury (Orleton)	1.09	- 1.52	.59	17	7	77.0	9, 27	32.0	1	1	1	
VII.	Leicester (Barkby)	1.64	- 1.00	.73	21	15	79.0	8	37.0	11	0	0	
"	Boston	.41	- 2.36	.17	3	5	85.0	24	40.0	13	0	...	
"	Hesley Hall (Tickhill)	1.28	- .88	.56	21	10	78.0	8	35.0	1	0	...	
VIII.	Manchester (Plymouth Grove) ..	1.13	- 2.34	.20	30	15	80.0	8	42.0	1	0	0	
IX.	Wetherby (Ribston Hall) ...	2.40	- .06	.48	22	9	...	...	...	...	...	...	
"	Skipton (Arncliffe)	4.04	- .72	1.27	30	17	79.0	8	42.0	13	0	...	
"	Hull (The Park)	1.44	- 1.00	.72	21	11	...	...	...	...	...	...	
X.	North Shields	2.65	- .01	.70	23	15	73.5	8	...	...	...	...	
"	Borrowdale (Seathwaite).....	15.88	+ 4.15	6.79	30	19	...	...	...	...	...	...	
XI.	Cardiff (Ely).....	.87	- 2.87	.40	19	9	...	...	...	...	...	...	
"	Haverfordwest	3.02	- 1.38	1.22	17	14	70.0	6	39.0	10	0	0	
"	Plinlimmon (Cwmsymlog) ...	2.89	- ...	.45	23	12	...	...	...	...	...	...	
"	Llandudno	1.68	- .54	.40	30	15	75.1	8	47.9	13	0	...	
XII.	Cargen [Dumfries]	3.03	- .53	.54	20	17	71.6	6c	39.8	1	0	...	
"	Jedburgh (Sunnyside).....	1.64	- 1.05	.39	30	14	75.0	3, 8	43.0	13a	0	...	
XIV.	Old Cumnock	5.72	+ 1.89	.89	2	18	72.5	8	34.0	9	0	...	
XV.	Lochgilphed (Kilmory).....	8.13	+ 3.00	1.84	30	21	...	...	...	...	...	...	
"	Oban (Craigvarren)	6.80	- ...	1.85	30	21	70.0	8	46.0	30	0	...	
"	Mull (Quinish)	5.86	+ .83	1.11	25	21	...	...	...	...	...	...	
XVI.	Loch Leven Sluices	3.60	+ .81	2.20	30	8	...	...	...	...	...	...	
"	Dundee (Eastern Necropolis) ..	2.85	+ .34	1.35	30	8	75.6	7	42.4	1	0	...	
XVII.	Braemar	3.01	+ .15	1.08	30	16	72.2	7	37.3	13	0	...	
"	Aberdeen (Cranford)	1.51	- ...	.65	30	13	76.0	3, 8	41.0	29	0	...	
XVIII.	Strome Ferry	5.52	+ .65	2.05	25	21	...	...	...	...	...	...	
"	Inverness (Culloden)	1.71	- .74	...	...	...	74.0	7	50.0	30	0	9	
XIX.	Dunrobin	2.72	+ .13	1.30	30	11	69.5	7	40.0	6	0	...	
"	S. Ronaldsay (Roseberry).....	2.92	+ .26	.65	30	18	63.0	7	48.0	30	0	...	
XX.	Cork (Blackrock).....	2.24	- .76	.92	20	11	78.0	5, 27	32.0	26	1	...	
"	Dromore Castle	3.65	- .38	.82	20	17	68.0	6	40.0	1	0	...	
"	Waterford (Brook Lodge) ...	2.32	- .60	.86	20	10	72.0	3, 11	43.0	18	0	...	
"	O'Brienbridge (Ross)	3.66	- ...	1.43	21	16	75.0	6	45.0	22f	0	...	
XXI.	Carlow (Browne's Hill)	2.28	- .54	.65	20	15	...	...	...	...	...	...	
"	Dublin (Fitz William Square) ..	2.47	+ .50	.88	20	14	71.2	7	48.3	23	0	...	
XXII.	Ballinasloe	3.42	+ .63	.93	30	18	68.0	7	40.0	17	0	...	
XXIII.	Waringstown	3.23	+ .07	.60	20	20	77.0	9	39.0	18a	0	...	
"	Londonderry (Creggan Res.) ..	5.57	+ 1.79	1.18	22	22	...	...	...	...	...	...	
"	Omagh (Edenfel)	3.56	+ .18	.86	17	19	70.0	7	43.0	9, 24	0	...	

a And 19, 28. b And 9, 10. c And 7, 15. d And 22. e And 29. f And 23, 25.

+ Shows that the fall was above the average; - that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—A beautiful month, with cloudless skies and a high temperature. The R in the third week was very welcome for root crops. Numerous wild flowers in full bloom.

HITCHIN.—The driest September in the 40 years recorded here, and the hottest but one.

ADDINGTON.—The whole month very fine. In low-lying places tender plants were much injured by frost on the 1st of the month, the temp. on grass falling below 30°.

BURY ST. EDMUNDS, WESTLEY.—The R of the month is less than that of any other September since 1865, when it was 11 in. A lovely warm month, but R much wanted at the close. T on the 17th and 23rd.

LANGTON HERRING.—A most beautiful month, and very favourable for the ingathering of the late harvest. On the 6th the temp. rose to 75°·0, only 1° below that of the hottest day (May 25th); only on the 1st did the temp. fall below 50°, and throughout the month the temp. was very equable, and the mean is 1°·7 above the average of 18 years.

BODMIN, FORE STREET.—A remarkably dry September. Brilliant and mild weather to the 16th; heavy R on the 17th; high winds on 19th, 23th, and 30th; very hot on the 28th and 29th.

WOOLSTASTON.—A warm, bright month of summer weather; a perfect harvest month. Mean temp. 58°·7.

BARKEBY.—A lovely month; abundance of sunshine; temp. very high; harvest well ripened and well got. Some splendid sunsets. Mean temp. 59°·5, considerably above the average.

MANCHESTER, PLYMOUTH GROVE.—R the smallest in September for 24 years. Summer weather from the 6th to the 19th; the rest of the month very unsettled. Mean temp. 59°·7.

HULL, PEARSON PARK.—The weather during the month was unusually fine, with a small amount of cloud, and nearly free from fogs or mist.

SEATHWAITE.—Very heavy R on the 30th, 6·79 in.

WALES.

HAVERFORDWEST.—The first five days were cloudy, damp, and relaxing; after that a remarkably fine warm period set in, with constant bright sunshine; this continued until the 17th, when a rather sudden change occurred, with violent gale, and much R; the day temp. fell very much, but the night temp. continued high up to the end of the month, the mean being about the average

SCOTLAND.

CARGEN.—The mean temp of the month, 57°·6, is 3°·1 above the average, and the month was the warmest month of the year, the mean temp. being 3° above that of June, 1°·4 above that of July, and 1°·7 above that of August. On only two occasions during 31 years has the mean temp. of this month been exceeded in September, viz., 1880, when it was 58°, and 1865, when it was 60°. The night temp. was unusually high, 3°·2 above the average. On the night of the 27th the temp. did not fall below 60°·4; on only one occasion has the temp. been exceeded in September. Duration of sunshine below the average. L on 17th, 18th, and 20th.

JEDBURGH.—The weather during the month was on the whole very fine, and such as to allow the cereal crops to be generally secured except in the higher districts.

OBAN.—A very broken, wet month, typical of the whole summer season; farming operations almost arrested, and most of the corn crops obliged to

remain uncut. The E storms of the 28th and 30th produced serious floods, which did much damage.

CULLODEN.—Much sunshine throughout the month, the days being beautifully fine. Harvest well advanced by the close, except in exposed and high districts; all crops exceedingly full and heavy.

ROEBERRY.—The first part of the month was fine, the last part rough and unsettled. Heavy gale on 29th from westward, doing great damage to uncut crops.

IRELAND.

DROMORE.—The latter half of the month was very unsettled.

WATERFORD, BROOK LODGE.—Fog on 8th, 9th, 18th, and 27th. Gale from the S. on the 20th. Mean temp. $58^{\circ}\cdot 1$.

O'BRIENBRIDGE, ROSS.—A short but brilliant Michaelmas summer from 4th to 14th. The last week of the month wild and wintry, wind S. and S.W.

DUBLIN.—As in 1888 and 1889, so in 1890, September proved a fine month, with a high mean bar. The prevailing winds were from warm quarters, chiefly S.W. There was no excessive E, and the temp. was remarkably high. From the 5th to the 15th inclusive conditions were anti-cyclonic, and the weather was summerlike. On the 20th a violent gale occurred, accompanied by heavy E. Taken as a whole, however, the month was very favourable from an agricultural as well as from a health point of view, and was the warmest September for a quarter of a century.

OMAGH, EDENFEL.—The month commenced in the same rainy humid weather that has been so characteristic of the summer, but from the 5th to the 15th there followed a magnificent spell of fresh, clear, warm weather, as nearly perfect as it could be. On the 16th it again became unsettled, with E and strong winds, and from the 20th to the end continued wet.

A DRY PERIOD.

To the Editor of the Meteorological Magazine.

SIR,—The deficiency in our rainfall continues with increased intensity. September, the average for which on 17 years is $2\cdot 52$ in., only yielded $0\cdot 66$ in. The total deficiency on the first nine months of 1890 is $6\cdot 26$ in. from an average of $19\cdot 00$ in. For the 12 months (October 1st, 1889, to September 30th, 1890) it is $8\cdot 68$ in., from an average of $26\cdot 56$ in.; and for the 16 months since June 1st. 1889, it is $11\cdot 44$ in. from an average of $36\cdot 55$ in. May 1889 was the last really wet month we had; of the 16 which have passed since then, only two were at all above the average, viz.: January, 1890 + $0\cdot 07$ in. and March, 1890 + $0\cdot 57$ in. The following have all produced considerably less than 1 inch of rain:—

		inch
1889.	June	$0\cdot 55$
"	November	$0\cdot 77$
1890	February	$0\cdot 82$
"	April	$0\cdot 55$
"	September	$0\cdot 66$

As compared with the 13 years average (1874—1886), the deficit of the last 12 months would be $9\cdot 93$ in. These results as compared with the heavy rainfalls in other parts seem remarkable.

Yours very truly,
G. H. MULLINS.

West Deyne, Uppingham, Oct. 2nd 1890.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCVIII.]

NOVEMBER, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

HAIL INSURANCE.

IN the *Meteorological Magazine* for November, 1876, the following short letter appeared :—

HAIL STORMS—AN EXPLANATION NEEDED.

To the Editor of the Meteorological Magazine.

SIR,—I enclose a proposal for an insurance against hail, and you will see in the last paragraph that “All crops growing within twelve miles of Somersham railway station, Huntingdonshire, are charged double the usual rate,” and this is the custom of all insurance companies. I shall be very glad if any of your correspondents can explain why there should be twice as many hail storms in that district as in any other district in England.

I think it is an interesting subject for meteorologists.

I am, yours faithfully,

A. S. LESLIE MELVILLE.

The Long Hills, Lincoln, Oct. 1876.

Fourteen summers have passed, we have heard of no exceptional storms in the district singled out for double charges, and the explanation needed in 1876 is equally needed in 1890.

We are not the only ones puzzled by this rule. Mr. Todd, the assistant at Cambridge Observatory, has been making enquiries, and for many years has been watching the local newspapers to see if any heavy hail storms were reported, but has not succeeded in detecting any special destructiveness in the storms in that neighbourhood, or in obtaining any evidence to warrant the extra charge.

On the contrary, in his last letter he tells us that in 1882 he received letters from Mr. Westwood Oliver, asking for any trustworthy accounts of heavy hail storms in the Somersham district, in which Mr. Oliver stated that the insurance companies had, first doubled their rates, and then finding that that arrangement failed to yield a profit, resolved to decline insurances altogether.

Somersham is on the edge of the Fen district; we have, therefore, searched Miller and Skertchley's *The Fenland*, because, both on account of the elaborate nature of the work, and of Mr. Miller's reputation as a meteorologist, any special phenomenon was pretty sure to be mentioned, but we have read the whole chapter on meteorology, extending from p. 226 to p. 293, of that work, and can-

not find even the word hail! Moreover (as our older readers will remember) Mr. Miller published during 1874-5-6 & 1877 a monthly periodical, *The Fenland Meteorological Circular and Weather Record*, and although, of course, it contains some accounts of hail storms, we have not found one within the area of which the companies seem so much afraid.

Agreeing perfectly with Mr. Leslie Melville, that this is a question for meteorologists, we invite any information bearing upon it.

Our impression is, that, in the early days of Hail Insurance, two, or perhaps three, heavy losses were incurred in that district, and thereupon some clever manager jumped to the conclusion that it was a dangerous district. The rates were put up accordingly, and they have remained excessive because there is no competition between the companies, and because the farmers have not combined to insist upon a reduction.*

The area thus surcharged is 452 square miles, or nearly 300,000 acres; it extends from near Cambridge to near Peterboro', and includes March, Ely, Chatteris and Huntingdon. Why do not the farmers form a company of their own, instead of paying double charges to strangers?

If there is any justification for the charge, we shall be very glad to afford space for its insertion.

SHARPEST FROST IN OCTOBER FOR HALF-A-CENTURY.

WHOLE winters pass sometimes without a frost as sharp as that of October 28th, 1890; we therefore give a few particulars of it.

The following table gives in column 1 the date of every year since 1840 in which the temperature at Greenwich has in October fallen below 30°; column 2 gives the lowest air temperature in those Octobers; and column 3 the date on which it was recorded. The last two columns refer to Camden Square, London, and give the minima for the same months and years as were characterized by exceptional frosts at Greenwich.

* We have often had to refer to the good work done for Meteorology by the Rev. Leonard Jenyns (now Rev. Leonard Blomefield), and although we are not aware at what date this surcharge was first made, we have an impression that Mr. Jenyns's *Observations in Meteorology* (1858), which we have just been reading while it accords remarkably with the above hypothesis, possibly gives the actual date of the origin. The following is an epitome of the facts he records. On August 2th, 1843, tremendous thunderstorms occurred in various parts of England, and in the vicinity of Cambridge (which is only just outside the surcharged area—about two miles outside to the S.S.E.), it was accompanied by tremendous hail, many rooks and pigeons, as well as smaller birds, were killed by it, the damage in the University and town was considered to exceed £25,000. One farmer at Quy (about two miles outside the radius to the S.E.) suffered to the extent of £2,000, and three hours after the storm the hail in that parish was so deep that a gentleman's horse could not pull the carriage through it, and when the owner got out to make a track for the wheels, he *sank up to his knees*. If all this had but happened inside the area instead of outside, we should have considered the puzzle solved. Is it possible that the authorities were shaky as to their geography?

It will be noticed that occasionally the dates are very different.

YEAR.	LOWEST TEMPERATURE IN OCTOBER.			
	GREENWICH.		CAMDEN SQUARE.	
	Temperature.	Date.	Temperature.	Date.
1842	28.3	20	No observations.	
1843	28.5	18	"	" 24
1859	26.5	24	26.6	24
1862	28.5	30	31.8	30
1868	29.3	20	27.8	19
1869	27.9	28	26.6	28
1872	29.1	14	31.8	13
1873	26.7	29	26.2	30
1877	28.2	18	30.9	19
1880	29.2	30	29.6	30
1881	26.2	17	27.3	17
1887	25.3	13	25.4	26
1888	27.9	8	28.2	8
1890	24.7	28	23.8	28

It is remarkable that instead of the last 25 years including, as theoretically it should have done, half of the instances of low temperature, it contains 10 out of 14; moreover, the lowest, and the lowest but one, have both occurred in the last four years. This last October gives the absolute lowest both for Greenwich and for Camden Square.

But it was still colder in the more central parts of England. We cannot vouch for all the following readings being from verified thermometers, with no spirit at the top of the tubes, and duly hung in Stevenson's screens, but their general consistency shows that there is not much the matter. We give the readings in the order of temperature, starting with the lowest, and in order to keep the table within reasonable length, stopping at 22°; but we may add that in the greater portion of Scotland and Ireland the weather was not at all severe.

Lowest Temperatures on 27th-28th Oct., 1890.

County.	Station.	Observer.	Temp.	Date.
Leicester ...	Barkby Vic.	Rev. E. N. Pochin....	16.0	27th
Derby	Willington.....	Rev. G. A. Smallwood.	16.0	28th
Roxburgh ...	Melrose, Abbey Gate ...	Mr. Dodds ..	17.8	28th
Ayrshire....	Old Cumnock	Mr. J. Ballantine	18.0	27th
Herts	Broxbourne	G. J. Newbery, Esq. ...	19.0	27th
Bucks	Winslow, Addington ...	Mr. Mathison	19.0	28th
Surrey	Reigate, Holmfels	Miss Baker	19.4	28th
Leicester ...	Loughboro', Victoria St..	W. Berridge. Esq.	20.0	28th
Lincoln	Boston	W. H. Wheeler, Esq. CE	21.0	28th
"	Horncastle (Hemingby).	Rev. E. S. Bengough ..	21.0	28th
Montgomery.	Carno (Tybrith)	Miss Marsh	21.0	27th
Yorkshire ...	Wakefield	Dr. Clarke	21.2	28th
Hampshire...	Strathfield Turgiss	Rev. C. H. Griffith ...	21.7	28th

GREENWICH MEAN TEMPERATURES.

To the Editor of the Meteorological Magazine.

SIR,—May I point out how misleading the Greenwich method of calculating the mean temperature of months is apt to be? I do not precisely understand what that method is, but it certainly is *not* the mean of the max. and min. temperatures, but a value obtained by the aid of certain corrections, which, as we are expressly warned, are not applicable to localities other than Greenwich. This must be clearly borne in mind in making comparisons between the mean temperature of Greenwich and that of other places, as probably most people's idea of mean temperature is the mean of the max. and min.; certainly it is that of the large majority who only read their thermometers once in 24 hours.

For instance in the paper on the "Climate of Brighton," quoted in your September number, Mr. Sawyer places the mean temperature of Brighton and of Greenwich for September, October and November in parallel columns, and heads them, "arithmetical mean daily max. and min. temperatures." This is no doubt a correct description of his own Brighton values, but a totally incorrect one of the Greenwich values. The following are the actual values for Greenwich on the mean of 1841-88 :—

	Max.		Min.		Mean.	Mean in Mr. Sawyer's paper.
September.....	67.2	.....	49.1	.....	58.1	56.6
October	57.8	.....	43.2	.....	50.5	49.5
November	48.8	.....	37.6	.....	43.2	42.4

thus agreeing very closely with the Brighton values, and the whole theory as to the higher mean temperature of the latter place falls to the ground. I have taken the period 1841-88, for Greenwich, as the longest during which observations have been kept on a uniform system at the observatory, and the results made accessible to outsiders, though perhaps it would be more accurate to have taken exactly the same period as at Brighton, but Mr. Sawyer does not state distinctly what that was. I have discovered with some trouble that what Mr. Sawyer has adopted for Greenwich, are certain values called "mean temperature at Greenwich for 118 years," and probably he knows no more than I do how they have been obtained. It must, however, be evident that they are quite unsuitable for comparison with ordinary people's mean values, which in nine cases out of ten are the mean of the max. and the min.

It seems a pity that some uniform method of calculating mean temperature is not settled on authority, so that all values may be strictly comparable.

Yours faithfully,
G. VON U. SEARLE.

BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—I have been very much interested in the computation by Mr. Dines, of the energy stored up in our storms in the form of vapour to be set free on its condensation. It is a little singular that, with the exception of Prof. Mohn, of Christiania, no theorist has undertaken such calculation, as far as I know, though it would seem a legitimate field for airy fancies. I can see that in Europe where storms (cyclones) have erratic paths, and very slow motion, Espy's stationary cyclone theory might be accepted largely, but in this country where storms not infrequently have velocities of 40 or 50 miles per hour, such a theory seems doubtful. More than that, it is conceded that the upper part of a storm travels twice as fast as the lower part; so Mr. Dines's steam cylinder, which must be vertical if it is to act at all, in a very few minutes would become nearly horizontal, and he would lose his ascending current, and all its supposed power. In this country, too, nearly all our rain, thunderstorms and tornadoes occur 400 miles from the storm centre. It seems to me this consideration alone is fatal to all his computations. To take a certain rainfall over a limited area, and compute the amount of energy to be developed by determining the amount of steam in the free air, would be about as valuable as it would be to compute the amount of energy stored up in an ice house, and set free when it is set on fire. If there were a rarefaction as supposed in the atmosphere due to the liberation of latent heat, would not this partial vacuum be filled almost at once by the surrounding air rushing in? Would it be possible to maintain such an uprushing current as theory demands more than a very few minutes? The great need of meteorology to-day is to establish the fact of an uprush of air in the centre of our storms, and after that is done, that would be the best proof in the world that that has nothing to do with our storms, because there is no rain there, just exactly where it should be if there is any uprush.

H. A. HAZEN.

October 21, 1890.

To the Editor of the Meteorological Magazine.

SIR,—It appears to me that when Mr. Ryves complains of the treatment he has received, he should remember the proverb, "He who plays at bowls must expect rubbers."

With respect to his letter to you, pp. 138-9, I remark when he speaks of "the piling up of air in huge anti-cyclones," he has virtually assumed what, if I remember correctly the beginning of the discussion, was the point to be proved. The term "depression" was originally applied to the curve in the daily barometric chart as affected by a cyclonic or other storm. Then when weather charts of large districts became common, the idea of depression was strengthened by the similarity to maps of districts drawn with contour lines to

denote the physical features of the earth ; but that such charts denote a pit in the atmosphere any more than an anti-cyclonic area denotes a piling up, seems opposed both to observation and sound reasoning.

Your obedient servant,

JOHN SLATTER.

Whitchurch, Oxon, 23rd Oct., 1890.

To the Editor of the Meteorological Magazine.

SIR,—Nothing could possibly have been further from my intention than to inflict pain by recommending study. That the tone of my letters should have produced this result is to me a matter of deep regret.

Not being surprised that Mr. Ryves should prefer to my garrulity the reserve of my friend, the Hon. Ralph Abercromby, I wonder that he does not himself follow the wiser path. However, he has given us an interesting historical account of conclusions to be derived from Sir J. Herschel's theory, which is very far from being "unmitigated nonsense."

To return to modern times, those readers who wish to follow the most recent development of the question will find, in addition to Ferrel's works, much of interest in late papers in the "Amer. Met. Journal;" also on the anti-condensation view in the American Weekly "Science," and above all in Prof. Hann's most valuable "Remarks on the Temperature in Cyclones and Anti-cyclones," "Met. Zeitschrift," Sept. 1890, pp. 328-344.

I hope hereafter to shew that the high temperature prevailing at the altitude of a few thousand feet in our winter anti-cyclones is the necessary concomitant of the downward flow of the atmosphere in these systems. The subject, which is highly important, is too wide for a letter.

I should be the last man to wish, or to dare, to administer a "knock" to Dr. Muirhead. He appealed to common sense, and his appeal was unanswerable ; observation proves that in every cyclone the winds near the earth incurve towards the centre, and curve out aloft, and in every anti-cyclone curve out near the earth's surface, and incurve above ; so that we can (for once without mathematics), conclude that the air ascends in the first kind of system, and in the second descends. Thus, in a cyclone the isobaric surfaces, near the earth, are convex to the latter ; somewhere above they are concentric to it ; and further up they are concave to it. In an anti-cyclone, near the earth, isobaric surfaces are concave to the earth's surface ; somewhere further up they are concentric to it ; and further up still they are convex to it. Observation, however, everywhere indicates.

I. That these systems are far from extending to any hypothetical limit of the atmosphere.

II. That their axes are rarely, if ever, perpendicular to the earth's surface.

III. That these lines are usually far from being right lines.

Yours truly,

W. CLEMENT LEY.

REVIEWS.

Note sur une trombe d'eau dont la bouche est en bas et dont le corps est horizontal et peut avoir quinze cents fois son diamètre, par M. D. COLLADON. [Extrait des *Archives des Sciences physiques et naturelles*.] Genève, 1890. 8vo. 10 pages.

THE first half of this paper deals chiefly with the views of M. Faye, as stated in his *Sur les tempêtes*, and with the very beautiful arrangement whereby Prof. Colladon produced artificial waterspouts by rotating the surface of water in a large vessel. The author also refers briefly to a case in which the upward movement of the air was rendered very conspicuous by its whisking a lot of linen laid out to dry, up to an altitude of more than 1,500 feet, and then scattering it on the other side of the town. As the sun was shining, the white linen enabled the whole phenomenon to be traced with ease.

In the latter part of the paper (in illustration of which he has been kind enough to send us two photographs) he describes a very curious phenomenon, which he calls a horizontal waterspout, which is produced at some sluices at Geneva. The sluices are of a form not usual in England, but the nature of which may be indicated by some homely illustrations. Imagine a bridge very strong, and with arches of only 4 ft. span; imagine, secondly, a series of planks like very thick Venetian blinds, which, instead of drawing up like blinds, can be rolled up like a carpet; if one of these rolls is unrolled and dropped in front of the arch it will close it, and if all the rolls are let down no water can go through the bridge. It is found that occasionally, when the centre sluices are down (*i.e.*, closed), and the side ones are up, so that the water is running through the two ends, a hollow snake-like tube of air is formed from each end, which runs back, and the two join into one; this tube varies in size, but is from half-an-inch to four inches in diameter, and has sometimes been seen to be 50 ft. long.

Water swirls have, of course, received consideration in treatises on hydrodynamics, and their parallelism with air motions has been considered, especially by Hirn*, but Professor Colladon has carried the research much further. The phenomenon is certainly a very curious one, and we are glad that its study is in such competent hands.

* *Etude sur une classe particulière de Tourbillons qui se manifestent, sous de certaines conditions spéciales, dans les liquides. Analogie existant entre le mécanisme de ces Tourbillons et celui des Trombes*, par G. A. HIRN. Paris, 1878. 8vo., 40 pages, 3 plates.

A Comparison between the Jordan and Campbell-Stokes Sunshine Recorders. By F. C. BAYARD, LL.M., F.R.Met.Soc. [From *Quar. Jour. Roy. Met. Soc.*]

WE call attention to this paper because we believe that few persons are aware of the difference between the records of *sunshine* by the Campbell-Stokes burning instrument, and of the *sunlight* by the Jordan photographic one.

Mr. Bayard, as the result of observations on 355 days during 1888 and 1889, found the duration to be—

	Sunshine.		Sunlight.
Summer	100	.....	121
Autumn	100	.....	120
Winter	100	.....	146
Spring	100	.....	131
Year	100	.....	130

Stronger evidence of the necessity for avoiding confusion between the two modes of observation could hardly be imagined.

A WARM DRY SEASON.

To the Editor of the Meteorological Magazine.

SIR,—As another month has closed with a rainfall very much below the average, I think it well to write to you to mention the following facts relating to this very extraordinary season. The total rainfall for the first ten months of this year is only 19·05 in., the smallest amount registered at this place since 1830, except in the years 1842, 1844, 1854 and 1887, in all of which it was slightly less. While in London and the eastern part of the country, the ground was soaked with rain in June and July, here it has been so dry all through the summer and autumn that it has been almost impossible to work it. In many places springs have failed and are failing now, that have never been known to fail before.

Then again, although the mean temperature of the four months, June, July, August and September, was higher than in any year since 1878, except 1884 and 1887, the maximum temperature (77°·3) is the lowest but two since 1860. In the year 1862, the thermometer never rose above 75°, and in 1883, never above 77°. In 1879, the coldest summer but one (1888) on record, the thermometer reached 77°·7 one day which is slightly above the maximum for this year, and in 1888 it touched 81°·3 on the 10th of August. If, however, the number of days be taken on which the thermometer has reached 70°, it will be found that the number for this year is vastly in excess of that for either of the other years. This year the number has been 52, and in 1862, 1879, 1883 and 1888 it was respectively, 19, 15, 39 and 19.

Another curious thing about this year is that from June 8th to October 8th, the maximum was never below 60°, a length of time which is, I think, almost unprecedented.

Yours truly,

T. H. NEWPORT DAVIS.

Orleton, Tenbury, November 8th, 1890.

SUPERNUMERARY RAINBOWS.

THERE must have been exceptional uniformity in the rain showers which passed over the South-East of England on the afternoon of Sunday, August 24th, for supernumerary rainbows were seen by Captain Maclear, R.N., and by Rev. H. G. Wooley, from the neighbourhood of Guildford, and by Mr. Symons from Brighton. The phenomenon is not a very common one; it consisted of a series of bands of colour close to the violet on the inside of the primary bow. Captain Maclear described them as (proceeding inwards) Red, Green, Purple, Green, Purple; Mr. Wooley, in the same order, called them Neutral, Purplish red, Neutral, Purplish red, Neutral, Purplish red; and Mr. Symons as Red, Green, Red, Green, Red, Green.

Captain Maclear very neatly describes them as "not very bright nor definite, but patchy in density and colouring, and this patchiness varied in position." These supernumerary arcs were at no time more than 20° of the total bow, but they were sufficiently distinct to attract the attention of many who were not meteorologists.

GREAT RAINS AT MADRAS, 1803-88.

To the Editor of the Meteorological Magazine.

SIR,—In the account of the great rainfall at Hong Kong in your May number there is a reference to the fall at Madras in 1846. Perhaps the enclosed return (sent me by a brother) of the rainfall registered at the Royal Observatory, Madras, in 24 hours, during the present century, may interest some of your readers.—Yours faithfully,

C. S. PRINGLE.

Beckenham, 15th September, 1890.

Rainfall in 24 hours in the present century, as registered at the Royal Observatory, Madras.

			Inches.				Inches.
1803.	Nov.	18	8·27	1836.	Nov.	27	7·77
1811.	May	(?)	16·38	„	Nov.	20	9·65
1813.	Nov.	3	7·90	1846.	Oct.	21	20·58
1815.	Nov.	28	8·63	1851.	May	4	11·45
1819.	Sept.	12	10·00	„	Nov.	4	7·90
1820.	May	9	11·12	1857.	Oct.	24	18·04
1822.	Nov.	4	7·83	1864.	Nov.	18	9·35
1825.	Oct.	29	8·88	1866.	Dec.	5	7·99
1827.	May	9	12·08	1872.	May	18	13·01
				1888.	Oct.	31	9·20

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE,
1889.

REGULAR readers of the *Magazine* will be familiar with the fact that in the Annual Summaries of the Climate of the British Empire, the extremes are monopolised year after year by the same stations.

For the last five years Adelaide has recorded the highest temp. in shade, reaching $112^{\circ}4$ in 1886, but Calcutta has once or twice approached it very nearly. The opposite extreme is similarly held by Winnipeg, but without rivalry, for only once does any other station come within 20° of it. With an extreme min. of $-46^{\circ}4$, or nearly 80° below freezing point, a rival is perhaps neither to be expected nor desired. Winnipeg might well boast of a *lively* climate, for in addition to the above it holds the first rank for extreme range (the temp. in 1886 having risen to 103°) for mean daily range, for lowest mean temp., and is robbed by Toronto of another well deserved glory from the fact that readings of the min. on grass are not taken. Still one more honour has to be added to the long list, for this year Winnipeg has the smallest rainfall.

The least mean daily range is affected by the absence from the table of Barbados, but Mauritius has an almost equally uniform climate. Similarly Bombay usurps the place usually held by Colombo, which year after year records a mean temp. exceeding 80° .

Adelaide, in addition to the highest temp. in shade and in sun, has the driest atmosphere, the mean humidity in the five years ranging from 56 to 63; this station has also once recorded the smallest rainfall.

For moisture several of the insular stations run very closely together, but London—perhaps by the aid of its fogs—carries off the palm most frequently, and for amount of cloud it comes near the head of the list.

Malta, with little more than half the cloud of London, added to its other attractions, seems very enticing to a denizen of the metropolis with its winter mantle of fog.

SUMMARY.

<i>Highest Temperature in Shade</i>	$109^{\circ}0$ at Adelaide on January 13th.
<i>Lowest Temperature in Shade</i>	$-42^{\circ}6$ at Winnipeg on February 23rd.
<i>Greatest Range in Year</i>	$139^{\circ}2$ at Winnipeg.
<i>Least Range in Year</i>	$26^{\circ}4$ at Mauritius.
<i>Greatest mean Daily Range</i>	$24^{\circ}5$ at Winnipeg.
<i>Least mean Daily Range</i>	$9^{\circ}9$ at Mauritius.
<i>Highest mean Temperature</i>	$80^{\circ}5$ at Bombay.
<i>Lowest mean Temperature</i>	$35^{\circ}9$ at Winnipeg.
<i>Driest Station</i>	Adelaide mean humidity, 63.
<i>Dampest Station</i>	London mean humidity, 81.
<i>Highest Temperature in Sun</i>	$170^{\circ}7$ at Adelaide.
<i>Lowest Temperature on Grass</i>	$-18^{\circ}6$ at Toronto.*
<i>Greatest Rainfall</i>	73.79 in. at Trinidad.
<i>Least Rainfall</i>	14.95 in. at Winnipeg.
<i>Most Cloudy Station</i>	London, average amount, 6.6.
<i>Least Cloudy Station</i>	Malta, average amount, 3.7.

* There being no grass min. thermometer at the other Canadian stations.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE FOR 1889.

STATIONS.	ABSOLUTE.				AVERAGE.						ABSOLUTE.		TOTAL RAIN.		AVER- AGE.
	Maximum.		Minimum.		Max.	Min.	Mean.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.		
	Temp.	Date.	Temp.	Date.											
<i>Those in Italics are South of the Equator.</i>															
England, London ...	84.5	June 6	19.2	March 4	56.8	42.7	49.8	43.2	81	128.3	13.5	in.	169	0-10	
Malta	104.1	July 20	40.8	March 17	72.3	58.9	65.6	55.6	75	158.8	34.9	23.84	89	6.6	
Cape of Good Hope.	98.3	January 24	32.4	August 2	70.2	53.5	61.9	...	...	...	...	26.04	...	3.7	
Mauritius	84.4	January 2, 14	58.0	June 18	78.5	68.6	73.6	64.8	76	142.3	48.5	30.98	208	5.0	
Calcutta	101.8	May 2	48.6	January 2	86.7	71.1	78.9	70.8	75	161.2	37.4	56.19	...	5.9	
Bombay	94.3	March 6	63.8	January 15	86.1	74.9	80.5	71.9	76	147.7	49.8	57.47	129	4.1	
Melbourne	99.8	December 26	31.3	July 12	67.2	50.0	58.6	48.6	71	152.3	23.4	67.84	103	3.9	
Adelaide	109.0	January 12	36.3	July 19	71.7	53.9	62.8	49.3	63	170.7	29.0	27.14	125	5.9	
Wellington	80.0	January 24	31.5	June 13	62.1	48.6	55.4	47.2	75	139.0	23.0	30.87	143	5.1	
Trinidad	96.0	May 10	60.0	January 19	88.8	70.1	79.5	72.4	78	161.5	54.0	31.37	155	4.1	
Toronto	88.7	July 8	-11.3	February 6	53.2	37.7	45.5	39.1	77	...	-18.6	73.79	...	...	
New Brunswick, Fredericton.....	91.7	May 19	-33.0	February 24	52.7	32.7	42.7	37.3	74	...	...	31.24	179	6.3	
Manitoba, Winnipeg	96.6	August 30	-42.6	February 23	48.2	23.7	35.9	30.2	77	...	...	39.15	148	5.8	
British Columbia, Victoria	85.0	July 8, 9	24.0	January 14	58.7	41.8	50.2	...	...	...	...	14.95	132	5.2	
									...	...	...	18.56	103	...	

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	64·3	30	30·5	5	54·9	38·7	37·6	83	110·9	23·2	3·02	16	5·9
Malta.....	75·9	18	45·3	30	67·0	54·7	51·9	78	132·3	37·3	·64	5	4·7
Cape of Good Hope ...	91·3	1	44·2	14	62·8	54·7	...	...	...	...	2·14	...	5·9
Mauritius.....	82·4	1	66·8	27	79·3	70·7	68·7	83	139·4	58·8	10·24	22	6·8
Calcutta	105·6	24	67·2	28	95·1	76·5	74·6	71	155·8	61·0	1·00	3	2·5
Bombay	92·8	12	74·5	1	88·4	78·0	74·1	74	144·2	63·5	·01	1	3·0
Ceylon, Colombo	90·1	2	73·0	29	87·6	75·3	72·9	79	149·0	70·0	14·27	27	7·1
Melbourne.....	87·5	7	40·0	28	69·6	50·6	50·2	71	136·2	34·8	1·82	6	4·6
Adelaide	85·1	5, 6	46·4	17	74·4	55·1	49·8	58	144·0	37·6	1·00	7	4·3
Wellington	72·0	11	43·0	24	65·5	53·3	51·0	73	135·0	35·0	3·71	11	4·7
Auckland	72·0	1	50·0	23	68·4	57·3	54·5	74	135·0	40·0	5·52	18	6·6
Jamaica, Kingston.....	90·3	20	65·0	25	86·3	67·9	66·9	72	...	...	·26	...	...
Trinidad	88·0	11a	66·0	3	84·4	70·0	70·1	80	157·0	61·0	7·62	21	...
Toronto	68·4	13	23·5	1	51·7	32·8	32·3	69	...	15·0	2·11	14	5·1
New Brunswick, Fredericton	67·8	23	11·7	2	47·7	27·5	24·0	52	...	...	1·77	7	4·2
Manitoba, Winnipeg ...	69·8	19	8·4	1	49·2	26·0	29·3	70	...	...	1·21	10	4·3
British Columbia, Victoria	70·0	28b	24·0	12	55·7	36·9	...	...	...	...	·86	6	...

a And 21, 28. b And 29, 30.

REMARKS.

MALTA.—Mean temp. 59°·3; mean hourly velocity of wind 11·8 miles. Sea temp. rose from 60°·6 to 62°·9. J. SCOLES.

Mauritius.—Mean temp. of air 1°·7 below, of dew point 0°·6 above, and rainfall 4·61 in. above, their respective averages. Mean hourly velocity of wind 8·2 miles, or 2·6 below the average; extremes 21·7 on 6th, and 1·8 on 24th; prevailing direction E.S.E. to E. by N. T and L on nine days; L on five days. Unusually bright and prolonged skyglows before sunrise and after sunset after the 24th.

C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on sixteen days, and L only was seen on ten days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 0°·9, and of dew point 0°·8 above average, humidity 1, amount of cloud 1·3 and R·45 in. below average. Prevailing winds N., S.E., and S. Strong on four days. Heavy dew on nine days, L on the 21st.

R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. 0°·5 above the average. The weather, on the whole, was fine and pleasant, but somewhat dry for the season. C. TODD, F.R.S.

Wellington.—Strong winds on the 1st and 2nd, but generally fine weather up to the 11th; from 11th to 18th very showery, unpleasant and oppressive; the remainder of the month fine, with moderate winds, chiefly N. and N.W. Mean temp. 2°·4 above, and rainfall very near, the average. R. B. GORE.

Auckland.—A wet stormy month, the rainfall being 2½ in. above the average. Mean temp. slightly above the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
OCTOBER, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	1.25	XI.	Castle Malgwyn	4.98
„	Margate, Birchington...	1.48	„	Builth (Llanwrtyd Wells)	5.24
„	Littlehampton	1.29	„	Rhayader, Nantgwillt..	4.61
„	Hailsham	1.61	„	Carno, Tybrith	3.24
„	Ryde, Thornbrough	1.24	„	Corwen, Rhug	2.66
„	Alton, Ashdell	1.57	„	I. of Man, Douglas	2.17
III.	Oxford, Magdalen Col..	1.14	XII.	Stoneykirk, Ardwell Ho.	2.59
„	Banbury, Bloxham	1.13	„	New Galloway, Glenlee	3.65
„	Northampton	1.31	„	Melrose, Abbey Gate...	1.88
„	Cambridge, Fulbourne..	2.16	XIII.	N. Esk Res. [Penicuik]	4.35
„	Wisbech, Bank House..	1.07	XIV.	Ballantrae, Glendrishaig	2.19
IV.	Southend	.89	„	Glasgow, Queen's Park.	3.00
„	Harlow, Sheering ...	1.67	XV.	Islay, Gruinart School..	5.02
„	Rendlesham Hall	1.33	XVI.	Dollar	5.15
„	Diss	1.49	„	Balquhider, Stronvar..	6.52
„	Swaffham	1.89	„	Coupar Angus Station..	2.06
V.	Salisbury, Alderbury ...	.56	„	Dunkeld, Inver Braan..	2.18
„	Warminster	...	„	Dalnaspidal H.R.S. ...	7.17
„	Bishop's Cannings	1.23	XVII.	Keith H.R.S.	5.04
„	Ashburton, Holne Vic....	2.67	„	Forres H.R.S.	2.88
„	Hatherleigh, Winsford. ...	...	XVIII.	Fearn, Lower Pitkerrie.	2.54
„	Lynmouth, Glenthorne.	3.09	„	Loch Shiel, Glenaladale	19.61
„	Probus, Lamellyn	3.11	„	N. Uist, Loch Maddy ...	9.23
„	Launceston, S. Petherwin	3.16	„	Invergarry	7.75
„	Wincanton, Stowell Rec.	1.87	„	Aviemore H.R.S.	4.27
„	Taunton, Lydeard Ho....	...	„	Loch Ness, Drumadrochit	4.54
„	Wells, Westbury	2.05	XIX.	Lairg H.R.S.	7.73
VI.	Bristol, Clifton	1.67	„	Scourie	8.18
„	Ross	1.25	„	Watten H.R.S.	4.63
„	Wem, Clive Vicarage ...	1.60	XX.	Dunmanway, Coolkelure	4.19
„	Cheadle, The Heath Ho.	2.30	„	Fermoy, Gas Works ...	1.53
„	Worcester, Diglis Lock	1.09	„	Tipperary, Henry Street	2.71
„	Coventry, Coundon	1.72	„	Limerick, Kilcornan ...	2.12
VII.	Ketton Hall [Stamford]	1.24	„	Miltown Malbay	3.65
„	Grantham, Stainby	1.11	XXI.	Gorey, Courtown House	1.51
„	Horncastle, Bucknall ...	.90	„	Navan, Balrath	1.19
„	Worksop, Hodsoc Priory	1.01	„	Mullingar, Belvedere ...	2.06
VIII.	Neston, Hinderton	2.96	„	Athlone, Twyford	2.44
„	Knutsford, Heathside ...	2.36	„	Longford, Currygrane...	2.29
„	Lancaster, South Road.	3.26	XXII.	Galway, Queen's Coll...	2.81
„	Broughton-in-Furness ..	6.08	„	Clifden, Kylemore	6.12
IX.	Wakefield Prison	.65	„	Crossmolina, Enniscoe..	3.39
„	Ripon, Mickley	.74	„	Collooney, Markree Obs.	4.18
„	Scarborough, West Bank	2.21	„	Ballinamore, Lawderdale	2.94
„	East Layton [Darlington]	1.60	XXIII.	Warrenpoint	1.37
„	Middleton, Mickleton ...	2.07	„	Seaforde	1.47
X.	Haltwhistle, Unthank..	2.25	„	Belfast, New Barnaleay..	3.14
„	Shap, Copy Hill	2.30	„	Bushmills, Dundarave...	3.47
XI.	Llanfrecchfa Grange	1.23	„	Stewartstown	1.86
„	Llandovery	4.80	„	Buncrana	3.96

OCTOBER, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which "01 or more fall.	TEMPERATURE				In shade.
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Deg.	Date		Deg.	Date			
				Dpth.	Date.								
											inches.	in.	
I.	London (Camden Square) ...	1.20	— 1.69	.28	25	13	68.5	4	23.8	28	2	2.4	
II.	Maidstone (Hunton Court)...	1.05	— 2.41	.38	26	10	...	...	...	...	...	4.8	
III.	Strathfield Turgiss	1.15	— 1.69	.31	25	16	67.0	5	21.7	28	1	4.8	
III.	Hitchin	1.57	— 1.50	.45	7	11	64.0	1, 4c	29.0	27	7.11	7.11	
IV.	Winslow (Addington)	1.24	— 1.85	.38	7	12	72.0	4	19.0	28	...	...	
V.	Bury St. Edmunds (Westley) ..	1.85	— 1.42	.54	7	13	...	...	...	...	...	...	
V.	Norwich (Cossey)	1.69	— 2.15	.32	31	14	...	...	...	...	...	...	
V.	Weymouth (Langton Herring) ..	1.18	— 2.36	.27	25	14	65.0	6	32.0	28	1	6.0	
"	Barnstaple	2.90	— 2.19	.62	31	14	69.0	15	33.0	20	...	...	
VI.	Bodmin (Fore Street)	4.50	— 1.50	.83	26	20	...	...	...	...	...	...	
VI.	Stroud (Upfield)	1.37	— 1.66	.37	25	12	67.0	3	29.0	27	2	2.0	
"	Church Stretton (Woolstaston) ..	2.12	— 1.65	.44	6	18	64.5	4	31.0	28	2	2.6	
"	Tenbury (Orleton)	1.33	— 1.88	.32	7	16	69.5	4	26.8	28	5	5.6	
VII.	Leicester (Barkby)	1.37	— 1.78	.43	16	13	68.0	6	16.0	27	5.14	5.14	
"	Boston	.85	— 2.26	.18	15	11	75.0	4	21.0	28	4	4.0	
"	Hesley Hall [Tickhill]	.86	— 2.24	.20	28	11	69.0	12	24.0	28	3	3.0	
VIII.	Manchester (Plymouth Grove) ..	2.38	— .99	.45	16	18	70.0	12	23.0	27	2	2.8	
IX.	Wetherby (Ribston Hall) ...	.62	— 2.51	.14	16a	5	...	...	...	...	...	...	
"	Skipton (Arnellife)	4.45	— 1.58	.81	6	20	64.0	1	29.0	27	2	2.0	
"	Hull (Pearson Park)	1.19	— 2.46	.24	26	14	...	...	...	...	...	...	
X.	North Shields	2.42	— .53	.65	26	16	65.0	5	...	...	...	...	
"	Borrowdale (Seathwaite)	11.64	+ 1.05	1.56	14	21	...	...	...	...	...	...	
XI.	Cardiff (Ely)	2.15	— 2.39	.47	7	17	...	...	...	...	...	...	
"	Haverfordwest	3.10	— 2.05	.65	6	18	64.0	6	35.1	9	0	0.4	
"	Plinlimmon (Cwmsymlog) ...	6.51	...	1.18	6	16	...	...	...	...	...	...	
"	Llandudno	1.74	— 1.65	.32	25	16	66.3	10	35.8	23	0	0.0	
XII.	Cargen [Dumfries]	1.50	— 1.76	.44	14	12	62.4	12	23.0	28	4	4.0	
"	Jedburgh (Sunnyside)	1.54	— 1.11	.26	14	13	64.0	4	29.0	28	3	3.0	
XIV.	Old Cumnock	3.70	+ .30	.58	14	19	62.0	5, 10	18.0	27	9	9.0	
XV.	Lochgilhead (Kilmory)	6.33	+ 1.54	.97	14	27	...	...	27.0	27	3	3.0	
"	Oban (Craigvarren)	8.76	...	1.75	2	26	58.0	12	32.5	26	0	0.0	
"	Mull (Quinish)	7.83	+ 2.54	1.16	2	27	...	...	...	...	...	...	
XVI.	Loch Leven Sluices	3.10	+ .14	1.00	31	12	...	...	...	...	...	...	
"	Dundee (Eastern Necropolis) ..	2.00	— .24	.50	30	12	64.6	5	29.0	28	3	3.0	
XVII.	Braemar	4.45	+ .84	1.15	16	21	61.0	10	28.4	27	3	3.1	
"	Aberdeen (Cranford)	3.54	...	.61	1	22	72.0	12	31.0	27	4	4.0	
XVIII.	Strome Ferry	10.41	+ 4.74	2.11	28	29	...	...	...	...	...	...	
"	Inverness (Culloden)	3.73	+ 1.48	.77	1	...	63.0	5	29.0	26	3	3.0	
XIX.	Dunrobin	...	...	...	...	...	...	...	...	...	...	...	
"	S. Ronaldsay (Roeberry)	4.74	+ 1.01	1.26	2	24	60.0	12d	32.0	27	1	1.0	
XX.	Cork (Blackrock)	1.24	— 2.43	.62	6	8	69.0	4	35.0	1, 26	0	0.0	
"	Dromore Castle	5.59	— .05	1.50	6	14	64.0	7	32.0	26	1	1.0	
"	Waterford (Brook Lodge) ...	1.46	— 2.36	.58	6	11	65.0	4	35.0	2g	0	0.0	
"	O'Briensbridge (Ross)	3.43	...	1.26	6	16	67.0	1	37.0	16	0	0.0	
XXI.	Carlow (Browne's Hill)	2.18	— 1.11	.75	6	17	...	...	...	...	...	...	
"	Dublin (Fitz William Square) ..	.64	— 2.74	.16	25	11	65.2	5	34.2	27	0	0.0	
XXII.	Ballinasloe	2.01	— .98	.30	24	18	60.0	10e	31.0	27	3	3.0	
XXIII.	Waringstown	1.80	— .91	.32	6	15	64.0	4	31.0	26	2	2.0	
"	Londonderry (Creggan Res.) ..	3.50	— .17	.43	15	21	...	...	...	...	...	...	
"	Omagh (Edenfel)	2.81	— .29	.32	6b	19	61.0	5	33.0	26	0	0.0	

- And 30. b And 25, 30. c And 5, 6. d And 13. e And 11. f And 28. g And 26, 27.
+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON OCTOBER, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURBIS.—A fine mild open month with a high temperature in the early portion. A very sharp and short burst of cold occurred from 25th to 28th, the grass min. on the morning of the latter day, falling to 18°·9.

ADDINGTON.—There were many very fine days during the month, but dense fogs occurred on 11th and 22nd. Towards the end of the month a remarkable and sudden change of temp. occurred; on the morning of the 28th the min. in shade fell to 19°, it was cold all day, frosty in the evening up to 7 o'clock, when a change took place, and by 9 a.m. on the 29th the temp. had risen to 47° and to 59° by mid-day.

BURY ST. EDMUNDS, WESTLEY.—A beautiful autumnal month; very mild, except on the 27th, when there was a sharp frost; S fell on 26th.

LANGTON HERRING.—On the whole a very fine month. The temp. which in the last week was remarkably variable, was on the whole a little less than 1° above the average for 18 years. On the 28th the min. was 32°, on the 30th the max. was 61°, the greatest range remembered in so short a time. Fogs on 12th, 13th and 22nd; T on 26th.

BODMIN, FORE STREET.—Splendid weather to the 24th; on the 26th and 27th H, sleet, heavy R, high wind, T and L, then much milder to the end; the last night very stormy and wet.

STROUD, UFFIELD.—This neighbourhood was greatly in want of water, most of the springs having run dry, and many wells failed.

WOOLSTASTON.—A beautiful autumn month; mean temp. 49°·8. A heavy storm of H occurred on the 15th, and S fell lightly on 25th, and two following days.

ORLETON.—Another very fine dry month, with the R much below the average. Rather unusual extremes of temp. occurred; many of the days being quite hot, and others excessively cold for the time of year. Mean temp. of the month slightly above the average. A heavy snow storm on the morning of the 26th, covered the ground to a depth of 1½ inches on the high ground.

BARKBY.—A fine month. Sudden and very hard frost on the 16th, and the leaves of many kinds of trees came off in one night; considerable scarcity of water, brooks and springs very low. T and L on 15th, T L and H on 16th.

MANCHESTER, PLYMOUTH GROVE.—Fine autumn weather from 2nd to 13th and also on the 18th, 19th, 24th and 30th. On the morning of the 27th, the min. on grass fell to 17°, the lowest temp. in October for 24 years. The rest of the month very unsettled, cold, wet and stormy. H on 25th. Sleet on 28th. Mean temp. 48°·5.

HULL, PEARSON PARK.—The weather during the month was generally fine; often bright and clear, but showery from the 24th to the end.

WALES.

HAVERFORDWEST.—Generally damp and wet throughout, but some very fine days with bright sunshine, as R frequently fell during the night. On the 26th the wind veered to N.W., with much lower temp., H fell in vast quantities through the day, with squalls of wind, and a terrific display of L occurred from 6 to 9 p.m.; a terrible H storm, accompanied by loud T, occurred on the morning of the 27th. Precipity was white and the air very cold. The month ended wet and milder. Prevailing winds W. and N.W.

SCOTLAND.

CARGEN.—The mean temp. of the month 49°·4, is 1°·4 above the average, the fluctuations of the bar. and ther. during the month were very marked, pressure varying on several occasions upwards of half an inch in 24 hours. The first 17 days of the month were unusually mild, the mean temp. oneight nights

during the first thirteen, ranging from 50° to $55^{\circ}8$. Sudden alterations in temp. occurred in the latter part of the month; the min. temp. on the night of the 28th being 23° , on the 29th $49^{\circ}2$, on the 30th 34° , and the 31st 45° . On the whole the month was gloomy and damp. Sunshine considerably below the average.

JEDBURGH.—The weather on the whole was very seasonable and favourable for all out-door work, and the cereal crop in high districts was all secured in good order. Snow on 26th.

OBAN.—After so wet a summer such a large R in October was most unexpected. All harvesting ceased, and the corn remained out in many places to the close of the month.

MULL, QUINISH.—The wettest summer and autumn ever known in this district.

ROBEERY.—A very rough and wet month throughout, with a heavy fall of S on 27th.

IRELAND.

CORK.—An unusually fine month. Mean temp. $53^{\circ}3$.

DROMORE.—The latter part of the month was very wet and stormy, with very heavy showers of H on 25th and 26th. The mountains being white with S winter seems to be setting in very early.

WATERFORD, BROOK LODGE.—Mean temp. $51^{\circ}8$. S on the Comeragh Mountains on the 26th; L on 27th.

O'BRIENSBRIDGE, ROSS.—Two periods of six days each of very fine autumn weather occurred. Temp. high for the season; stormy winds from S.W. in the last week.

DUBLIN.—The month will be remembered as one of the driest, finest and mild-est Octobers on record. During the first fortnight the temp. was almost always above the average; on the 25th a cold period set in, which culminated on the 27th, and was followed by mild, dull and damp weather to the end of the month. Mean temp. $51^{\circ}7$, considerably above the average. High winds on 14 days, attaining the force of a gale on the 15th only. Fogs on the 8th, 9th, 11th, 12th and 22nd; L on the 26th; S and sleet on the morning of the 26th; H on the 15th.

WARINGSTOWN.—A most beautiful month on the whole; all late farming operations satisfactorily cleared up. Gardens in beauty to the end. Potato crops in this district excellent.

OMAGH, EDENFEL.—With but little intermission the weather was fine, mild and favourable up to the 23rd, thence to the end very wet, with heavy S on the night of the 25th. Bright aurora on 21st.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCXCIX.]

DECEMBER, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

EXCESSIVE FROST IN NOVEMBER.

IN our last number we had to record an October frost unapproached for at least half a century. We now have to notice a more exceptional frost in November.

This November frost was an extremely remarkable one; (1) because it occurred in the daytime; (2) because it was so local.

As will be seen further on, the temperature fell much lower at other places than it did at Greenwich, or at Camden Square, but as long records are available at those places, it will be well first to examine what occurred at them.

Greenwich.—November 23rd was quite exceptionally warm; the average was $54^{\circ}9$, which was higher than on any day in the third decade of November during the 60 years, 1814 to 1873. Then a rapid fall of temperature set in, and on the 28th the maximum was $26^{\circ}9$, the minimum was $18^{\circ}3$, and the mean $21^{\circ}8$, which is nearly 2 degrees colder than any other day in November during the above-named long period of 60 years.

Camden Square.—Out of the 32 Novembers ending with that of 1889 there has been one (1888) in which there was no frost, there have been 14 in which the temperature fell below 27° , and four in which it fell below 23° , these cases being as follows:—

AIR TEMPERATURES IN NOVEMBER BELOW 23° .

1858.....	$20^{\circ}1$ on the 24th	1871.....	$21^{\circ}0$ on the 19th
1861.....	$21^{\circ}8$ on the 19th	1887.....	$22^{\circ}1$ on the 17th

In 1890 it fell below all these, excepting 1858—viz., to $20^{\circ}8$ on the 29th.

It is necessary to explain why the minimum at Greenwich is stated to be on the 28th and at Camden Square on the 29th. The minimum (as will be further explained subsequently) occurred nearly at the same time, 4—5 p.m. on the 28th, at both places, but at Greenwich for many years it has been the custom to record the temperatures as they would have been if read off at midnight. We believe that no readings are now really taken at that hour, but the theory has survived the practice. This minimum was therefore on the Greenwich system correctly set down to the 28th. The rule, however, for

climatological stations is that the maximum read on any morning is to be entered to the day before, but the minimum to the day on which it is read, because in an overwhelming majority of cases the minimum occurs in the early morning hours, and therefore belongs to the day on which (at 9 a.m.) it is read. Hence, in accordance with rule, the entry at Camden Square is for November 29th.

It will probably be most convenient if we reduce the many letters and notes with which we have been favoured, into the form of paragraphs, and sort them into counties, taking the usual "Rainfall" order, and taking the stations in each county as nearly as may be in the order of increasing latitude, *i.e.*, from south to north. The exceptional phenomena of the afternoon and evening of November 28th having been confined to the S. and S.E. of England, records from other parts are not generally quoted. Sharp weather prevailed in most parts of the country, and in the eastern counties it was much colder on the 30th than on the 28th. In those cases in which we are aware of the pattern of thermometer stand, we shall use the abbreviations *Stev.* for Stevenson's, and *Gla.* for Glaisher's.

MIDDLESEX.

Edith Road, Kensington.—Min. in *Stev.* 22°·2.—G. VON U. SEARLE.

Royal Botanic Gardens, Regent's Park.—Temp. in *Stev.* on November 28th, max. 25°·0; min. 20°·5; 3 p.m. 22°·5; 9 p.m. 23°·0.—W. SOWERBY.

Camden Square, London.—The lowest temp. was 20°·8 on *Gla.* and 21°·6 in *Stev.* The Richard thermograph sheet shows that the temperature fell steadily from noon to 5.5 p.m. on the 28th, when the above-mentioned minimum occurred; and it did not rise 1° until about 1 a.m. on the 29th, after which it rose steadily.—G. J. SYMONS.

Pinner Hill.—Min. on 28th, 21°.—H. E. SELLWOOD.

SURREY.

Hall Place, Cranleigh, Guildford.—This house faces S., and is 233 ft. above sea level; at 8 p.m. on 28th a ther. outside a S. window 15 ft. above ground, read 12°, at 11 p.m. 20°, and at 4 a.m. on 29th 22°.—E. S. ROWCLIFFE.

Abinger Hall, Dorking.—The 28th was bitterly cold, our ther. standing at 20° to 22° all day, and going down to 1° for a short time in the evening.—G. PAYNE.

Brockham, Betchworth.—Minimum in *Stev.*, 4°·5.—A. CHEALES.

Holmfels, Reigate.—Min. on 29th, 2°.—F. T. BAKER.

Emlyn House, Leatherhead.—The ther. in my garden, 3 ft. above ground and about 40 ft. above the river Mole, fell until 7 p.m. of 28th, when it registered 5°; there was very little wind.—A. T. MILLER.

Caterham.—In the valley between Caterham and Purley two persons had thermometers which fell to 2°.—CECIL E. BYRON.

Coulsdon.—This village is 520 ft. above sea-level, and here the temperature fell to 4°.—CECIL E. BYRON.

Ingleside, Kenley.—The temperature here fell to 9° in the stand and to 3° on the snow.—HAROLD SMITH.

Purley.—A thermometer outside a greenhouse read 5° at 6 p.m. on the 28th; the severity lasted only about two hours, say 5 to 7 p.m. The fingers of my left hand were so chilled in driving up from the station that on the fifth subsequent day I had recovered feeling in only two of them.—CECIL E. BYRON.

Wallington.—Min. in Stev. on 28th, 10°·3.—F. C. BAYARD.

Ormesby House, Grange Road, Sutton.—Temperature on snow on 28th, at 4.30 p.m., 4°; at 6.30 p.m., 7°; at 7 p.m., 12°; at 9 p.m., 15°·5; and at 11.45 p.m. it had again fallen, and stood at 4°·5, although no apparent change had taken place in the sky, which was uniformly clouded over.—W. THURTELL.

Addiscombe, Croydon.—Minimum in Stev., 10°·3.—E. MAWLEY.

Kew Observatory.—On November 28th, the max. was 25°·5 at 0.35 p.m., from which it fell steadily until 4.8 p.m., when the min. of 21°·5 was reached, and it remained within 1° of that point until after midnight.—G. M. WHIPPLE.

SEVERE FROST IN SURREY.—The weather here on the 28th ult. was phenomenal with regard to the severe frost. We registered at four o'clock on the above date 24° frost Fahr. [i.e., 8° F.], and at six o'clock the mercury showed 6° below zero. After that time it gradually rose above zero. In the Rev. W. Wilks' garden at Shirley, two miles from here, the thermometer registered 2° below zero; at Warminster, four miles, 5½° below, and at Riverhead, near Sevenoaks, 1° below zero. The shrubs here are turned quite black, the Aucubas especially seem ruined. I may mention that our thermometer registered the above at 6 inches from the ground. Enclosed herewith are a few leaves of shrubs and ivy to show the result.—R. H. COPPIN, *Addington, Croydon*. [The temperatures recorded are extremely low, but the thermometer is too near the ground. The leaves sent are blackened, and evidently the injury is severe.].—*Journal of Horticulture*.

We reprint this paragraph without assuming any responsibility for the accuracy of the thermometers. On the one hand, the records support each other, while on the other hand, one cannot but suspect that there must have been spirit at the top of the tubes or errors in the thermometers themselves.

KENT.

Dungeness.—Min. in air between 8 a.m. 28th and 8 a.m. 29th, 18°.—MET. OFF. WEATHER REPORT.

Hythe.—Min. in air on 28th, 15°.—H. B. MACKESON.

Cranbrook.—Min. temp. lower than for 25 years, viz., 10°.—G. PILE.

Goudhurst.—Min. 11°; lowest ever recorded in November.

—J. S. CLARKE.

Colebrook Park, Tonbridge.—This house is half-way between Ton-

bridge and Tonbridge Wells, and 350 ft. above sea level; I have usually two Rutherford min. thermometers in use, each about 2 ft. above the ground, and about 300 yards apart; one is an ordinary one by Negretti & Zambra, the other divided on its stem by Beck; each recorded 8° for the evening of the 28th. Finding it very cold, I, in the afternoon of the 28th, put out a third thermometer—a mercurial one. It read as follows:—4.30 p.m., 15° ; 5 p.m., 11° ; 6.15 p.m., $9^{\circ}5$; 11 p.m., 14° ; but the indices of each of the Rutherford's showed 8° , to which it must have fallen some time between 6.15 and 11 p.m. The night was intensely bright and still.—W. A. SMITH.

East Malling, Maidstone.—A Six's thermometer here fell to 8° .—W. A. SMITH.

Tower Fields, Keston, Farnborough.—The following are the temperatures during the afternoon and evening of 28th:—2 p.m., 21° ; 4 p.m., 17° ; 6.30 p.m., 14° ; 8 p.m., 17° ; 10 p.m., 22° ; 11 p.m., 23° .—G. BUCHANAN, M.I.C.E.

Foxgrove Road, Beckenham.—On returning from town I felt it very cold; I looked at the thermometer, it was then (6.30 p.m.) 15° , but had been down to 8° ; at 10.30 p.m. it had risen to 19° . Thermometer by Browning, 4 ft. from ground, facing N. It is most remarkable that this low temperature should have occurred during the daytime. I am told that there was a gleam of sunshine just before sunset. Was the sudden clearing of the sky the cause of the intense cold?—C. S. PRINGLE.

Foxgrove, Beckenham.—Temp. on Gla. stand on November 28th, 9 a.m., $23^{\circ}4$; about 5 p.m., minimum 10° ; 6.30 p.m., 17° ; 10.30 p.m., 19° ; max. of day, $27^{\circ}5$.—P. BICKNELL.

Royal Observatory, Greenwich.—Max. on Gla. stand, November 28th, $26^{\circ}9$; min., $18^{\circ}3$; min. in Stev. $18^{\circ}0$; min. on grass, $18^{\circ}1$. The temperature fell quite steadily to the min. at 4.20 p.m., and then rose with equal steadiness, rising $0^{\circ}8$ by 5.5 p.m.—W. ELLIS.

SUSSEX.

Church House, Heene, Worthing.—Min. in Stev. $14^{\circ}9$, the lowest that I remember recording during 22 years.—W. J. HARRIS.

Prestonville Road, Brighton.—Min. $16^{\circ}2$; on grass $14^{\circ}5$.—F. H. PHILLIPS.

South Park, Bodiam, Hawkhurst.—The thermometer here fell to 13° before midnight on 28th, the lowest I have recorded for ten years.—L. M. JACKSON.

Observatory, Crowborough Cross.—Min. in Stev. $11^{\circ}3$; exposed at 4 ft., $8^{\circ}6$; on snow, $3^{\circ}2$. Unprecedented in November during the present century.—C. L. PRINCE.

HAMPSHIRE.

East Tisted Rectory, Alton.—I wonder whether you have received record of any frost equal to that in this notoriously cold valley. My thermometer, 4 ft. above ground, and under its little penthouse

board as usual, stood at 1° , and so did another which had been verified at Kew.—F. HOWLETT.

Ashdell, Alton.—Min. in air on 29th, 14° .—F. CROWLEY.

Strathfield Turgiss.—Min. on 29th in Stev., $17^{\circ}6$; on grass, $14^{\circ}5$.—C. H. GRIFFITH.

HERTFORDSHIRE.

Broxbourne.—Min. $17^{\circ}0$ on 29th.—G. J. NEWBERY.

The Grange, St. Albans.—Min. in Stev., $19^{\circ}0$.—J. HOPKINSON.

Rosebank, Berkhamstead.—Min. in Stev. $21^{\circ}6$, and on grass $20^{\circ}8$ for 29th, but lower for 30th, viz., $20^{\circ}0$, and $9^{\circ}0$ on grass.—E. MAWLEY.

Hamels Park, Buntingford.—Min. for 29th 16° .—E. WALLIS.

Hitchen.—Min. 18° on 28th.—W. LUCAS.

BUCKINGHAMSHIRE.

Addington, Winslow.—Min. in Stev., 22° on 28th, 22° on 29th, and 20° on 30th.—J. MATHISON.

OXFORDSHIRE.

Magdalen College, Oxford.—Min. in air on 28th, $22^{\circ}5$.—E. CHAPMAN.

NORTHAMPTONSHIRE.

Castle Ashby.—Min. $21^{\circ}0$ on 28th.—R. G. SCRIVEN.

CAMBRIDGESHIRE.

Observatory, Cambridge.—Min. in air between 8 a.m. on 28th and 8 a.m. on 29th, 20° .—MET. OFF. WEATHER REPORT.

ESSEX.

Sheering, Harlow.—Min. in air on 29th and on 30th, 16° .—E. HILL.

SUFFOLK.

Bishops Hill, Ipswich.—Min. 17° on 29th and on 30th.—G. A. BIDDLE.

Rendlesham Hall, Woodbridge.—Min. in air on 30th, 17° .—RENDLESHAM.

NORFOLK.

Denver Rectory, Downham.—Unprecedentedly low minima for November. Ther. has no spirit at the top of the tube, and is in Stev. Min. on 27th, $23^{\circ}7$; 28th, $22^{\circ}5$ (lowest since 1862); 29th, 26° ; 30th, 17° (record of 28th further beaten).—J. M. DU PORT.

Cossey, Norwich.—Min. 5° on 30th.—ALBERT J. CULLEY.

East Dereham.—Min. at 4 ft. above ground, 17° on 29th.—G. H. COOPER.

WILTSHIRE.

Alderbury, Salisbury.—Min. in air on 28th, 11° .—R. S. HUTCHINGS.

Bishops Cannings.—Min. in air on 29th, 10° .—C. W. HONY.

DORSET.

Heatherlands, Parkstone, Poole.—About 5 p.m. on 28th temp. fell to 20° , and it continued to fall until just before 9 p.m. on that day,

when it reached the very low point of $16^{\circ}2$ in the air and (some time during the evening or night), $7^{\circ}9$ on the grass.—R. H. BARNES.

Langton Herring, Weymouth.—Min. 17° , being 4° lower than has been recorded in November during 19 years; on the grass the min. was 12° .—CLEMENT H. GOSSET.

DEVONSHIRE.

Babbacombe, Torquay.—Min. on 29th, $22^{\circ}3$ in Stev., and $21^{\circ}8$ on grass.—E. E. GLYDE.

Druid, Ashburton.—Min. on 29th, $19^{\circ}7$.—FABYAN AMERY.

Woodway, Teignmouth.—Min. on 29th, $21^{\circ}6$ in Stev., and $17^{\circ}0$ on grass, the lowest since commencing observations in 1879.—G. W. ORMEROD.

Barnstaple.—Min. 20° on 29th.

SOMERSETSHIRE.

Wells.—Min. on 29th in air, 22° , and on grass, 16° .—R. J. MANNING.

LEICESTERSHIRE.

Barkby, Leicester.—Min. $16^{\circ}0$ on 29th.—E. N. POCHIN.

RUTLANDSHIRE.

Ketton Hall [Stamford].—Min. on 29th, 25° ; on 30th, 11° .—F. COVENTRY.

LINCOLNSHIRE.

Boston.—Min. 13° on 30th.—W. H. WHEELER.

Hemingby, Horncastle.—Min. on 30th, in air, $8^{\circ}6$.—E. S. BENGOUGH.

JERSEY.

Hastings Terrace, St. Heliers.—Min. $20^{\circ}0$.—W. J. LANCASTER.

Noirmont, St. Aubins.—Min. in air between 8 a.m., 28th, and 8 a.m., 29th, 16° .—MET. OFF. WEATHER REPORT.

We may now epitomize the facts—as regards intensity and time. It is noteworthy that of all the records from verified thermometers in Stevenson's screens, only one is below 10° , viz., that at Brockham, near Dorking, where $4^{\circ}5$ was recorded.

The temperatures below even that are, in the order of intensity, the following :—*

Coulsdon, Surrey.....	4°	East Tisted, Alton, Hants ...	1°
Holmfels, Reigate, Surrey...	2°	Riverhead, Sevenoaks, Kent	-1°
Caterham Valley, „ ...	2°	Shirley, Surrey.....	-2°
Abinger Hall, Dorking „ ...	1°	Warmington, Surrey	$-5\frac{1}{2}^{\circ}$

Nearly all these stations are in the district of which the Meteorological Committee of the Croydon Microscopical Society is representative. We shall be glad to hear that they have investigated these and other records in their district and ascertained which are correct, which errors are due to spirit being lodged in the top of the tubes, which to faulty instruments, and which to bad exposure.

* We have omitted the records of 4° at Sutton, and of -6° at Addington, because in each case the thermometer was on, or close to, the snow.

Apparently, however, it can hardly be doubted that in the air the temp. on November 28th fell nearly to zero, and on snow below it.

The examination of the precise time of the phenomenon, which has necessitated plotting a large number of observations, tends to confirm our impression that it was a very local one—a down-rush of cold air, with probably a clear sky, allowing radiation for a short time in the vicinity of Caterham—and occurring between 4 and 6 p.m. In proof of its local character, it may be sufficient to give the temperature at four hours at Greenwich, Kew, and Camden Square :—

	3 p.m.	4 p.m.	5 p.m.	6 p.m.	Min.
Greenwich	20·8	19·5	19·0	21·0	18·3
Kew	23·0	22·1	22·0	22·4	21·5
Camden Square	22·8	22·5	21·7	21·0	20·8
Kew warmer than Greenwich...	+2·2	+2·6	+3·0	+1·4	+3·2
Camden Sq. warmer than „ ..	+2·0	+3·0	+2·7	+0·0	+2·5

This shows plainly that the intensity of cold was increasing in directions S. and E. of Kew and of Camden, and beyond Greenwich, in that direction, is the district of Kent and Surrey, whence the lowest records have been sent. So few hourly records have been received that we can say only that there is some indication that the minimum occurred later at stations furthest towards S. and E., but nowhere later than 7 p.m.

BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—Professor Hazen appears to have misunderstood the object of my letter. I understood him to say that the liberation of latent heat by the condensation of vapour could be shown to be physically incapable of supplying the energy of the cyclone, and I made the calculation (which he now implies to be inapplicable) simply with the view of combating his statement.

It is not probable that the axis of the cyclone is vertical, at least in temperate latitudes, neither does Ferrel's theory require that it should be so, but it is not at all clear how the upper part is to travel twice as fast as the lower, and the whole to remain one single storm for several days. Might we not as well say that the locomotive of a train travels twice as fast as the carriages? There can be little doubt about the ascensional current in the central parts of a cyclone—it follows inevitably from the fact of the inclination of the wind direction to the isobars, for there is no other possible direction in which the air, moving towards the centre, can escape. Also, the central parts of a cyclone are those in which the rain chiefly falls.

The same rule applies to thunderstorms, which are well known to be small secondary depressions, and that they chiefly occur in the south-eastern quadrant of the cyclone is often brought forward in support of Ferrel's theory.

W. H. DINES

ROYAL METEOROLOGICAL SOCIETY.

The opening meeting of the session of the Royal Meteorological Society was held on Wednesday evening, November 19th, at the Institution of Civil Engineers, when the President, Mr. Baldwin Latham, M.Inst.C.E., delivered an address on "The Relation of Ground Water to Disease."

The pages of history show that when the ground waters of our own or of other countries have arrived at a considerable degree of lowness, as evidenced by the failure of springs and the drying up of rivers, such periods have always been accompanied or followed by epidemic disease. In all probability, ground water in itself, except under conditions where it is liable to pollution, has no material effect in producing or spreading disease. As a rule, it is only in those places in which there has been a considerable amount of impurity stored in the soil that diseases become manifest, and the most common modes by which diseases are, in all probability, disseminated, are by means of the water supplies drawn from the ground, or by the elimination of ground air, into the habitations of the people. It is found that the periods of low and of high water mark those epochs when certain organic changes are taking place in the impurities stored in the ground, which ultimately become the cause, and lead to the spread, of disease. Mr. Latham defines "ground water" as all water found in the surface soil of the earth's crust, except such as may be in combination with the materials forming the crust of the earth. It is usually derived from rainfall by percolation, and it is also produced by condensation. In dry countries ground water is principally supplied by the infiltration from rivers, as for example, in the Delta of the Nile.

If but little water passes into the ground for a long period it naturally leads to the lowering of the water line, and to the drying of the ground above the water-line; and it is curious to note with reference to smallpox, that this disease generally occurs after there has been a long absence of percolation, and a consequent drying of the ground. On the other hand, smallpox is unknown when the ground has long been wet, or is receiving moisture by condensation or capillarity.

The study of the level of underground water shows that certain diseases are more rife when the water is high in the ground, and others when the water is low. The conditions that bring about and accompany low water, however, have by far the most potent influence on health, as low water years are, without exception, unhealthy. As a rule, the years of high water are extremely healthy, except, as often happens, when high water follows immediately upon markedly low water; on the rise of the water an unhealthy period invariably follows.

Mr. Latham has found those districts for which the water is drawn from springs are usually more subject to epidemics and disease

than districts supplied from rivers or extended areas, or from sources not liable to underground pollution. In the case of Croydon, one portion of the district (under three-fourths) is supplied with water taken direct from the ground, whilst the remaining portion is supplied with water from the river Thames. It is curious to note that even so recently as 1885, the zymotic death-rate in the district supplied with underground water was twice as great as in that part of the district supplied from the Thames ; and in that year 41 deaths from smallpox occurred in Croydon, every one of which occurred in the district supplied by the underground water.

Mr. Latham, in his address, dealt largely with zymotic diseases as affected by ground water, and showed that cholera ordinarily breaks out when there is least ground water ; a high air and earth temperature is also necessary for its development, and, as a rule, the low-lying districts are favourable to the production of these high temperatures. Smallpox is almost always preceded by a long period of dryness of the ground, as measured by the absence of percolation. Typhoid fever is most prevalent after a dry period, on the first wetting of the ground or percolation from any cause. The condition essential to the development of diphtheria is a damp state of the ground, marked by extreme sensitiveness to percolation of rain. Scarlet fever follows the state of dryness of the ground, which is essential for its development, and occurs in the percolation period. The conditions that precede smallpox are those favourable for the development of scarlet fever, and, like smallpox, the dampness of the ground for any considerable period in any particular locality may check its development or render it less virulent, and it is most rife in low water years. Measles are least prevalent at the low water periods, and mostly rife at and near high water periods. Whooping cough follows the percolation period in its incidence, increasing with percolation and diminishing as the waters in the ground subside. Diarrhoea is generally more prevalent in a low water year than in other years ; that is, with a very much colder temperature in a low water year there is a very much higher death-rate from this disease.

METEOROLOGICAL PHOTOGRAPHY.

As stated in the October number of this Magazine, a Committee of the British Association was appointed at Leeds to assist, foster, and systematize the application of photography to meteorology. The Committee has already commenced work, and prepared blank forms and instructions, copies of which will with pleasure be supplied by the Secretary, to whom, of course, all communications and offers of co-operation should be forwarded. It is most desirable that our readers, whether themselves photographers or not, should bring this effort to the knowledge of all their photographic friends, both in this country and abroad. The Committee consists of G. J. Symons, F.R.S. (Chairman), Professor R. Meldola, F.R.S., John Hopkinson, F.L.S., F.G.S., Arthur W. Clayden, M.A., F.C.S., F.G.S., (secretary), "Warleigh," Palace Road, Tulse Hill Park, London, S.W.

REVIEW.

Klimaschwankungen seit 1700 nebst Bemerkungen über die Klimaschwankungen der Diluvialzeit. Von Dr. EDUARD BRÜCKNER, a.o., Professor der Geographie an der Universität zu Bern. [*Geographische Abhandlungen herausgegeben von Prof. Dr. ALBRECHT PENCK, Band IV., Heft 2.*] Wien, E. Hölzel, 1890. 8vo. viii.—324 pages, 13 diagrams, and one plate.

THIS work is essentially one for thoughtful persons. It is one the compilation of which would frighten most men, by the vastness of the subject, and by the mass of material to be dealt with. It is an attempt to ascertain the existence, and, if any, the amount of climatic variation which our earth has undergone, both in remote and in historic times, and to this end Dr. Brückner has employed chiefly six varieties of data.

- (1) The dates of the opening and closing of navigation on Russian rivers.
- (2) Records of severe winters.
- (3) The dates of the vintages in France. (These have been recorded for more than three centuries.)
- (4) Details of annual rainfall.
- (5) " " " " temperature.
- (6) Sunspot frequency.

One fact will sufficiently indicate the labour compressed into this work—it contains returns from 804 stations for an aggregate of more than 36,000 years; another will illustrate the thoroughness with which it has been executed, the foot-notes, chiefly references to other writers upon the subjects, must number considerably over 500.

It will probably afford the best general idea of the scope of the work if we give the titles of each of the ten chapters, and say a few words on each.

The first deals with the present state of the question as to climatic changes, begins by defining climate, and then notices successively the changes during prehistoric (geologic) times, discusses briefly the question of alterations during historic times—(a) as regards rainfall, (b) as regards temperature—and ends by criticising somewhat severely sunspot and other cycles.

The second chapter is devoted wholly to the variations in the level of the Caspian Sea, which are shown to be almost entirely dependent upon, and synchronous with, climatic changes, and that though very uncertain, they seem to be of long period.

In Chapter III. Dr. Brückner deals with the variations in other seas and lakes which have no outlet, taking not merely those of Europe, but also illustrations from Asia, America, Africa, and Australia, Mr. H. C. Russell's observations on Lake George being especially useful.

In Chapter IV. he passes on to the question of the discharges of

rivers, and records of their levels, and concludes that his researches thus far have shown that there are considerable oscillations of climate, that they are approximately, but not strictly, synchronous over the globe, but that it is not clear whether they are produced by rainfall or by temperature, or a mixture of the two, nor what is the primary cause.

In Chapter V. Dr. Brückner attacks, in a very thorough and able way, the problem of the secular variation of rainfall. He has collected returns from nearly all parts of the world, reduced the values to their equivalent percentages, and given the results in considerable detail. But he has allowed himself such free scope in filling up missing years, in order to increase the number of records available for discussion, that, while we accept the tables as probably correct, and certainly representing what Dr. Brückner believes to be so, all the values must not be accepted as the arithmetical results of perfect records. Considering this fact, it is rather amusing that twice over he brings up English records in order to condemn them. It would take too much space to deal with both cases, but the examination of one has led us to notice that the Paris observations partly corroborate the great drought indicated by the Lyndon observations from about 1728 to 1767, to which attention has often been directed. Quoting from Mr. Symons's table,* Dr. Brückner

* "Report of the British Association, 1866," p. 286.

finds two records for part of that time, which run on long afterwards ; he compares their mean ratios thus :—

Lyndon—Chatsworth	1761-69	.....	—6·8
„	„	1770-98	 +4·9
Difference			 11·7

and adds, "therefore are the amounts of rain before 1770 about 11 or 12 per cent. too small." We do not see the reason for the "therefore;" it would have been equally fair to say "therefore are the amounts of rain [at Chatsworth] too large." But Dr. Brückner proceeds to say that a similar indication is afforded by the following values :—

		mm.	inches
Lyndon (Rutland),	1737-69 (23 years)	 mean 538	= 21·18
„	„ 1770-98 (29 „)	 „ 637	= 25·08

And on the strength of the above, he has cut the record into two portions. He may be right ; it is very difficult to say whether he is or is not ; but the existence or non-existence of that great drought cannot be so easily disposed of, and it is droll in the extreme to find that on page 136 Dr. Brückner charges the Paris records with being *wrong in the same direction as the Lyndon ones, and at about the same date*, and on p. 191 he gives that very year 1770 as closing a dry period, "eine Trockenperiode 1756-70."

(To be continued.)

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MAY, 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
England, London	77·6	25	39·1	31	65·5	45·8	44·1	68	120·2	34·0	1·25	13	4·9
Malta.....	80·4	6	53·0	4	73·3	58·8	56·8	76	139·4	47·8	·61	4	3·5
Cape of Good Hope	84·8	1	41·0	19	64·7	50·0	...	...	...	...	5·93	...	5·9
Mauritius.....	79·5	1	59·8	25	76·4	65·3	62·2	76	132·7	52·3	·82	7	4·2
Calcutta.....	105·4	8	67·2	16	95·3	77·1	76·8	74	157·8	66·8	5·34	15	4·2
Bombay.....	92·2	2	78·0	10	89·7	80·0	75·2	73	142·8	69·8	·06	2	2·5
Ceylon, Colombo	...	...	...	...	...	...	...	...	...	...	...	...	...
Melbourne.....	73·5	14	37·7	9	62·9	46·5	48·6	81	122·1	30·2	2·35	11	7·0
Adelaide	...	...	...	...	...	...	...	...	...	...	...	...	...
Wellington	68·0	2,3	37·0	12	58·3	46·4	...	...	110·0	28·0	3·86	18	4·0
Auckland	68·0	22	40·0	13	63·3	51·1	49·2	74	125·0	30·0	4·33	20	5·8
Jamaica, Kingston.....	89·2	15	67·5	2	87·2	71·0	69·7	73	...	...	1·22	...	...
Trinidad	89·5	19	65·0	20	85·9	69·5	70·1	79	158·5	62·0	5·14	15	...
Toronto.....	77·0	31	28·1	8	59·0	41·1	42·2	74	...	20·0	2·62	23	6·6
New Brunswick, } Fredericton	70·8	20	30·0	12	60·4	41·0	43·7	70	...	...	9·08	20	7·2
Manitoba, Winnipeg } British Columbia, }	78·6	29	17·3	1	55·2	30·4	34·0	68	...	...	1·15	10	5·6
Victoria	71·0	5,25	38·0	1,18 29	63·8	43·3	...	...	...	...	·98	7	...

REMARKS.

MALTA.—Mean temp. 64°·5 ; mean hourly velocity of wind 10·4 miles. Sea temp. rose from 62°·9 to 72°·0 T88 on 1st, 27th, and 31st. J. SCOLES.

Mauritius.—Mean temp. of air 2°·0, of dew point 1°·9, and R 3·52 in. below, their respective averages. Mean hourly velocity of wind 8·5 miles, or 1·6 below average ; extremes 27·9 on 3rd, and 1·6 on 2nd ; prevailing direction S.E. by E. to E.S.E. Unusually intense skyglows before sunrise and after sunset throughout the month. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·2, of dew point 2°·5, humidity 3, amount of cloud 0·4, and R 25 in. above their respective averages. Prevailing winds N.E. and N., strong on 18th and 28th. Heavy dew on 11 days. Fog on 8 days. R. L. J. ELLERY, F.R.S.

Wellington.—On the whole a showery month, although the total R was nearly an inch below the average. Strong wind from S. on 11th and 31st, and from N.W. on 28th and 29th, otherwise moderate in force. H on 11th and 12th. Temp. very near the average. R. B. GORE.

Auckland.—Showery and unsettled almost throughout. Mean temp. and pressure close to the average. R slightly above the average. T. F. CHERSEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 NOVEMBER, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	3.03	XI.	Castle Malgwyn	6.74
"	Margate, Birchington...	2.60	"	Builth(Llanwrtyd Wells)	8.31
"	Littlehampton	2.71	"	Rhayader, Nantgwillt..	10.26
"	Hailsham	3.47	"	Carno, Tybrith	9.58
"	Ryde, Thornbrough	2.84	"	Corwen, Rhug	7.41
"	Alton, Ashdell.....	2.11	"	I. of Man, Douglas	9.81
III.	Oxford, Magdalen Col...	1.51	XII.	Stoneykirk, Ardwell Ho.	9.74
"	Banbury, Bloxham	2.25	"	New Galloway, Glenlee	13.09
"	Northampton	2.68	"	Melrose, Abbey Gate...	4.47
"	Cambridge, Fulbourne..	2.06	XIII.	N. Esk Res. [Penicuik]	8.25
"	Wisbech, Bank House..	2.58	XIV.	Ballantrae, Glendrishaig	8.60
IV.	Southend	2.74	"	Glasgow, Queen's Park.	6.42
"	Harlow, Sheering	2.11	XV.	Islay, Gruinart School..	10.23
"	Rendlesham Hall	3.28	XVI.	Dollar.....	6.80
"	Diss	5.06	"	Balquhiddier, Stronvar..	11.80
"	Swaffham	3.42	"	Coupar Angus Station...	6.52
V.	Salisbury, Alderbury...	1.76	"	Dunkeld, Inver Braan..	6.39
"	Warminster	2.30	"	Dalnaspield H.R.S.	8.28
"	Bishop's Cannings	2.31	XVII.	Keith H.R.S.	4.68
"	Ashburton, Holne Vic....	7.03	"	Forres H.R.S.	2.83
"	Hatherleigh, Winsford.	2.83	XVIII.	Fearn, Lower Pitkerrie.	2.78
"	Lynmouth, Glenthorne.	4.45	"	Loch Shiel, Glenaladale	...
"	Probus, Lamelllyn	5.47	"	N. Uist. Loch Maddy ...	9.14
"	Launceston, S. Petherwin	4.75	"	Invergarry	8.64
"	Wincanton, Stowell Rec.	2.55	"	Aviemore H.R.S.	3.20
"	Taunton, Lydeard Ho....	...	"	Loch Ness, Drumnadrochit	3.10
"	Wells, Westbury.....	3.07	XIX.	Lairg H.R.S.	5.18
VI.	Bristol, Clifton	2.55	"	Scourie	5.39
"	Ross	2.05	"	Watten H.R.S.	3.80
"	Wem, Clive Vicarage ...	4.16	XX.	Dunmanway, Coolkelure	11.27
"	Cheadle, The Heath Ho.	5.97	"	Fermoy, Gas Works ...	5.08
"	Worcester, Diglis Lock	2.14	"	Tipperary, Henry Street	4.71
"	Coventry, Coundon	3.53	"	Limerick, Kilcorran ...	4.44
VII.	Ketton Hall [Stamford]	3.90	"	Miltown Malbay.....	6.69
"	Grantham, Stainby	3.64	XXI.	Gorey, Courtown House	4.37
"	Horncastle, Bucknall	2.45	"	Navan, Balrath	...
"	Worksop, Hodsock Priory	3.23	"	Mullingar, Belvedere...	6.76
VIII.	Neston, Hinderton	5.72	"	Athlone, Twyford	6.72
"	Knutsford, Heathside ...	6.04	"	Longford, Currygrane...	6.54
"	Lancaster, South Road.	6.48	XXII.	Galway, Queen's Coll...	7.15
"	Broughton-in-Furness ..	13.78	"	Clifden, Kylemore	15.66
IX.	Wakefield Prison	2.71	"	Crossmolina, Enniscoe..	9.98
"	Ripon, Mickley	3.80	"	Collooney, Markree Obs.	7.35
"	Scarborough, West Bank	2.91	"	Ballinamore, Lawderdale	8.83
"	East Layton [Darlington]	4.26	XXIII.	Warrenpoint	5.50
"	Middleton, Mickleton...	3.73	"	Seaforde	8.64
X.	Haltwhistle, Unthank..	5.01	"	Belfast, New Barnaley..	9.58
"	Shap, Copy Hill	8.16	"	Bushmills, Dundarave...	7.89
XI.	Llanfrechfa Grange	4.35	"	Stewartstown	7.52
"	Llandoverly	7.30	"	Buncrana	7.79

NOVEMBER, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE				
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Days on which -01 or more fell.		Max.		Min.		
				Dpth.	Date.			Deg.	Date.	Deg.	Date.	
		inches	inches.	in.								
I.	London (Camden Square) ...	1.62	- 1.04	.34	6	17	58.1	23	20.8	29	6	
II.	Maidstone (Hunton Court)...	3.69	+ .76	.90	25	21	...	...	...	...	...	
III.	Strathfield Turgiss	1.62	- 1.10	.48	6	18	58.3	23	17.6	29	1	
III.	Hitchin	1.89	- .79	.42	6	21	57.0	23	18.0	28	6	
IV.	Winslow (Addington)	2.16	- .77	.43	6	21	58.0	23	20.0	30	2	
IV.	Bury St. Edmunds (Westley) ..	2.93	+ .38	.65	23	17	53.0	23	15.0	29	7	
V.	Norwich (Cossey)	3.34	+ .77	.70	23	16	...	...	5.0	30	2	
V.	Weymouth (Langton Herring) ..	2.63	- 1.03	.42	9	21	57.0	1a	17.0	29	7	
"	Barnstaple	3.83	- .78	.57	6	18	59.0	9, 14	20.0	29	7	
"	Bodmin (Fore Street)	6.67	+ 1.20	.75	4	28	...	...	...	...	...	
VI.	Stroud (Upfield)	2.10	- 1.23	.37	6	21	58.0	16b	22.0	29	7	
"	Churchstretton (Woolstaston) ..	4.96	+ 1.44	1.33	8	23	59.5	19	21.0	27	7	
"	Tenbury (Orleton)	2.95	- .19	.82	6	22	60.6	23	21.8	30	10	
VII.	Leicester (Barkby)	3.07	+ .78	.52	23	21	59.0	23	16.0	29	16	
"	Boston	2.86	+ .66	.72	23	19	60.0	1	13.0	30	1	
"	Hesley Hall (Tickhill)	2.95	+ .93	.51	6a	23	59.0	19	21.0	27	13	
VIII.	Manchester (Plymouth Grove) ..	5.02	+ 2.02	1.02	22	23	58.0	19	26.0	26	7	
IX.	Wetherby (Ribston Hall) ...	2.72	+ .65	.61	7	11	...	...	...	...	...	
"	Skipton (Arncliffe)	9.71	+ 2.96	1.71	6	27	55.0	19	...	...	...	
"	Hull (Pearson Park)	3.03	+ 1.02	.65	23	19	...	...	...	...	...	
X.	North Shields	3.28	+ 1.25	.99	23	19	57.0	19	...	...	...	
XI.	Borrowdale (Seathwaite)	25.48	+ 10.69	2.69	6	23	...	...	...	...	...	
XI.	Cardiff (Ely)	4.42	- .49	.67	6	24	...	...	...	...	...	
"	Haverfordwest	6.95	+ 1.09	.85	6	22	59.0	22	22.0	29	7	
"	Plinlimmon (Cwmsymlog) ...	...	...	...	...	...	...	...	...	...	...	
"	Llandudno	5.81	+ 2.72	.99	6	21	58.0	2	29.1	30	3	
XII.	Cargen [Dumfries]	9.28	+ 4.72	2.32	6	20	56.4	19	22.0	27	9	
"	Jedburgh (Sunnyside)	4.16	+ 1.66	1.30	8	17	56.0	19c	20.0	29	14	
XIV.	Old Cumnock	8.11	+ 3.14	1.20	6	22	57.0	19	14.0	26	13	
XV.	Lochgilphhead (Kilmory)	11.91	+ 4.62	2.37	6	25	...	...	...	...	...	
"	Oban (Craigvarren)	10.49	- .19	1.30	29	25	58.6	20	23.9	27	5	
"	Mull (Quinish)	10.06	+ 3.07	1.66	29	28	...	...	...	...	...	
XVI.	Loch Leven Sluices	6.70	+ 2.74	2.00	7	15	...	...	...	...	...	
"	Dundee (Eastern Necropolis) ..	4.65	+ 1.95	1.45	6	17	55.9	19	23.5	29	8	
XVII.	Braemar	5.03	+ .45	1.32	6	18	54.0	19	10.0	27	12	
"	Aberdeen (Cranford)	5.56	...	1.35	6	25	60.0	19	21.0	27g	8	
XVIII.	Strome Ferry	7.81	- .07	.83	6	27	...	...	...	...	...	
"	Inverness (Culloden)	1.93	- .56	...	...	...	55.0	19	23.0	27	6	
XIX.	Dunrobin	3.47	+ .64	.97	6	14	57.5	19	24.8	27	8	
"	S. Ronaldsay (Roeberry)	5.29	+ 1.87	.83	1	24	52.0	30	32.0	26h	2	
XX.	Cork (Blackrock)	5.21	+ .58	.82	8	19	61.0	22d	23.0	28	8	
"	Dromore Castle	12.38	+ 6.70	1.70	2	23	57.0	11	22.0	28	8	
"	Waterford (Brook Lodge) ...	4.53	+ .86	.73	6	23	59.0	22a	26.5	9	9	
"	O'Briensbridge (Ross)	6.99	...	1.16	1	25	55.0	20	25.0	28	...	
XXI.	Carlow (Browne's Hill)	4.35	+ 1.29	.73	6	26	...	...	...	...	...	
"	Dublin (Fitz William Square) ..	4.21	+ 1.38	.63	10	27	63.0	19	26.3	29	3	
XXII.	Ballinasloe	6.50	+ 2.59	1.15	6	25	56.0	2	19.0	29	11	
XXIII.	Waringstown	8.11	+ 5.01	1.42	6	25	58.0	19	20.0	26	9	
"	Londonderry (Craggan Res.) ..	8.01	+ 3.49	1.47	6	28	...	...	...	...	...	
"	Omagh (Edenfel)	7.23	+ 3.36	1.23	6	26	55.0	14a	22.0	27g	6	

a And 19, 23. b And 19. c And 20. d And 23. e And 18, 19, 22, 23. f And 30.
g And 28. h And 27. i And 29.

+ Shows that the fall was above the average; - that it was below it.

METEOROLOGICAL NOTES ON NOVEMBER, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGIS.—The first three weeks were mild and uniform in temp.; a very decided change occurred on the 23rd, when severe weather set in, and continued to the end. The grass min. thermometer registered 14°·5 on the morning of the 29th. A short, sharp squall occurred at 6.45 p.m. on the 21st, accompanied by heavy R.

HITCHIN.—The 23rd was the hottest day so late in November ever recorded here, and the 28th was the coldest since 1858.

ADDINGTON.—From the 14th to 23rd the max. temp. in shade was rather high, but from thence to the end it was very cold, the min. shade temp. on the 27th, 28th, 29th, and 30th being 23°, 22°, 22°, and 20°; on the evening of the 30th it began to thaw, the wind changing to S.W. The month was very free from fogs. Snow on 3 days.

BURY ST. EDMUNDS, WESTLEY.—The month was mild and favourable for agriculture till the 25th, when great cold set in, and continued till the end, with a considerable fall of S.

LANGTON HERRING.—From the 1st to the 18th the weather was wet and mild; the last five days were unprecedentedly cold. On the night of the 28th the temp. fell to 17° in shade, and on the grass to 12°. Taking the whole month, the temp. was very slightly below the average. The range of temp. was the greatest in any month for the last 19 years, being 40°. A solar halo was observed on the 15th, L on the 2nd, T and L on the 9th.

BODMIN, FORE STREET.—A very stormy, wet, and cold month. The first 10 days very wet and stormy, and it continued showery until the 25th, when H fell with very high wind; hard frost from the 26th to the end of the month, and bitterly cold wind; S on the 27th and 28th. The coldest November for many years.

STROUD, UPPFIELD.—A fine, warm month, till the last few days. Gales on the 1st and 6th, L on the 9th, S on the 25th, 28th, 29th, and 30th.

WOOLSTASTON.—The first half of the month was wet, cold, and stormy, strong gales with very heavy R occurring from 6th to 8th. The weather then became quite genial, and the 18th, 19th, and 20th were warm summer days. Another gale occurred on the 23rd, and after this it became extremely cold, S falling on 27th and 28th. Mean temp., 42°·1.

ORLETON.—Temp. a little above the average. Heavy R on 5th, accompanied by a great gale of wind, the worst for several years. On the 20th the temp. was 60°, and on the 23rd 60°·6, the latter being the highest so late in the year for 30 years, though on November 18th, 1875, the temp. rose to 61°·3. From the 25th to the end of the month the weather was very cold, the maxima on the 27th and 28th being 33°·4 and 33°·2 respectively. S on the 27th and 28th.

BOSTON.—S on the 26th and 27th, eight inches deep.

MANCHESTER, PLYMOUTH GROVE.—Fine autumn weather on 1st, 5th, and 10th. Wet mist on 13th, 17th, and 18th; many damp and foggy days up to the 17th, but no dense fogs during the month. Heavy fall of S on 27th. On 26th and 28th the min. on grass fell to 20°. Mean temp., 42°·8.

HULL, PEARSON PARK.—From the 1st to the 12th the weather was generally showery; then mist or fog prevailed until the 21st; this was followed by stormy weather, often with heavy falls of S and H nearly to the end of the month.

WALES.

HAVERFORDWEST.—One of the most remarkable Novembers that I have observed. The first six days were very stormy, especially on the night of

the 6th; the wind exceeded in force in this gale any gale since the memorable one of December 8th, 1886 (lowest bar. 28.927 in.). The *B* was continuous, and greatly above the average. The temp. was, up to the 23rd, greatly above the mean; a sudden and abrupt change took place on the 24th, the wind shifted to N.N.E., and the mean temp. of the six days from the 24th to the 29th inclusive was 30°·8. I never registered such continuous cold in any previous November. The month ended mild and wet. Prevailing winds, W. and S.W.

SCOTLAND.

CARGEN.—The first half of the month was extremely wet and stormy; 6·73 in. of *B* fell during the first 14 days, 2·32 in. falling on the 6th. During 31 years this fall has only been exceeded once, viz., 8th February, 1869, when 2·34 in. fell. Sharp frost prevailed from 26th to 29th, the minimum temp. ranging from 26°·4 to 22°. *TS* on the 10th.

JEDBURGH.—Winter manifested its appearance by *S* and frost, but to no great extent. Out-door work was not stayed in any way. Great stillness prevailed in the atmosphere, and there was almost no fog.

OBAN.—*B* almost constant throughout the month, and in great quantity. Crops still remain exposed to the weather, and farming operations were at a standstill. There were no heavy gales. At the close, a sharp frost occurred with some *S*. So continuous a rain for nearly six months is without previous record in this district. Most of the crops are lost, but potatoes on elevated gravel beds are of fine quality, quite superior to those of the dry season of 1889.

CULLODEN.—The weather was very changeable; much *B* fell at intervals, with occasional high winds from W. and N.W. A slight earthquake occurred on 15th, at 10 minutes before 6 p.m.

ROBERRY.—A very coarse, wet month; the wettest since 1882.

IRELAND.

CORK.—Almost incessant *B* to the 17th, then mostly fine to the 23rd, and heavy squalls on the 24th. The last week fair and frosty, except the 29th and 30th, which were wet and foggy. Mean temp. 44°·1.

DROMORE.—Very wet, with a very severe frost during the last week.

WATERFORD, BROOK LODGE.—Gales on 2nd and 7th; fogs on 18th, 19th, and 20th; *S* on 26th and 27th. Ripe strawberries gathered on the 8th.

O BRIENSBRIDGE, ROSS.—The heaviest November *B* since 1883; much *L* and heavy gales in the first half of the month, sharp frosts on 27th, 28th, and 29th, and the month closed with a return of misty and mild weather.

DUBLIN.—A wet, stormy, cheerless month, reminding one of November, 1888, which was the wettest and most stormy for more than a quarter of a century. The weather remained open until the 24th, when a spell of snow-storms and bitter cold set in with peculiar suddenness. The *S* storm on the night of the 26th was the heaviest experienced since the memorable storm of January, 17th, 1881. High winds on 12 days, attaining the force of a gale on five. Fogs on four days, *H* on five days, sleet and *S* on 26th, 27th, and 28th. On the 30th the *S* rapidly disappeared, under the influence of a S.W. gale and warm *B*.

BALLINASLOE.—Very wet and cold; floods very high in both Shannon and Suck.

OMAGH, EDENFEL.—During the first 25 days *B* was almost incessant, with occasional strong winds, and on the 6th a gale, but generally with mild humid air and extreme dampness. On the 25th a slight fall of snow was followed by three days of dry, clear, keen frost, and on the 29th by a return to *B* and humidity. The wettest November in at least 26 years.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CCC.]

JANUARY, 1891.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

OUR THREE HUNDREDTH NUMBER.

To have been enabled to edit every one of three hundred consecutive monthly numbers is not given to many, and, looking back over the work of a quarter of a century, a feeling of thankfulness is naturally predominant.

We lay no claim to brilliancy or to financial success, or to a large circulation; but we are conscious of the friendliness of nearly all the leaders of Meteorological progress in both hemispheres. Perhaps because it is so small, but, be the reason what it may, we rejoice to know that the *Meteorological Magazine* has the highest honour which a book can have—that of being read. We know that this is so, because when we make a mistake (and of course the Editorial “we” is fallible), whether in dealing with Russia, America, or our Australian colonies, the very next mail is sure to tell us of it; and we rejoice that this is the case, for our whole aim has ever been to help forward the science which we love, and the best way to do that is to stamp out error wherever it can be found.

The 300th number tempts us much to draw up a resumé of the progress of the quarter of a century; but the temptation must be resisted, for irrespective of the impossibility of pronouncing judgment on the mass of facts and opinions contained in the 25 volumes, time and space are both wanting.

We have naturally had before us the question of preparing a general index. We believe that it would be very useful, but how the time and cost of preparing and printing it could be provided is not evident.

VOL. XXV.

N

THE FROST OF 1890-91.

WE are very glad to announce that this subject will be brought before the Fellows of the Royal Meteorological Society by a paper by a member of its Council, Mr. Charles Harding. Therefore, in accordance with our usual hatred of duplicate work, we shall here offer only some very general remarks, and shall pass on to Mr. Harding the mass of data, with which we have been favoured.

In the first place, as regards intensity. At Camden Square, the lowest was, on December 22nd, on Glaisher 14°·9, in Stevenson 17°·3. In 1860 and in 1867 the min. on Glaisher fell to 6°·7, therefore the intensity at that station has not been excessive on the present occasion. Reference to the table for January, 1867, in the *Meteorological Magazine* will show that 13 stations (just half of the whole number reporting) had minima of 10° or less. Reference to the table in the present number gives only 7 such stations, and they are but one-fifth instead of half of all those reporting.

As regards snow, we have had much less than in 1881. Therefore there is nothing very exceptional either in the intensity of the frost, or the depth of the snow.

But there has been one very unusual feature—the persistency of low temperature.

We do not assume that we have looked up all the cold periods, or that the following notes are perfect, but offer them *ad interim* and *quant val.* They are, of course, almost all taken from Mr. Glaisher's tables.

MEAN TEMP. AT GREENWICH BELOW 32°.

		Consecutive days.
1814.	January, from 1 to 26, both inclusive	26
1823.	January, from 9 to 26	18
1838.	January, from 8 to 21	14
1855.	January and February; from January 17 to 24, from January 27 to February 2, and from February 7 to 23	17
1860.	December, from 18 to 29	12
1866.	December } From December 31 to January 5; and from	
1867.	January } January 12 to 22	11
1870.	December } From December 21 to January 4.....	15
1871.	January }	
1881.	January, from 12 to 27.....	16
1890.	December } From December 10 to January 12, with the exception of December 26th and of January 1 and 4, on which days the mean temp. ex- ceeded 32° by 0°·9, 1°·0 and 3°·0 respec- tively. If these days be ignored, the total length of the frost would become.....	33
1891.	January }	

THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—In a note attached to a paragraph from the *Journal of Horticulture* in the December issue of your Magazine, reference is made to the doubtful accuracy of thermometers in gardens. I suspect

many are inaccurate. Several years ago, when I had charge of the gardens at Branston Hall, Lincoln, the present proprietor, A. S. Leslie Melville, Esq., induced me by his example, to take interest in meteorological observations. I found there nine thermometers in use, and had an opportunity of having them tested. Only one was correct. Some of the others were from two to five degrees too high, varying in different parts of the scale. A short time ago a Surrey gardener told me his thermometer registered 27° of frost (5° on the scale) and he had left the indicator in position to "show how cold it had been." Having a suspicion that something was wrong I made a journey to the garden in question. There, sure enough, was the indicator at 5° , the spirit then registering 34° . I particularly drew the attention of the gardener to that fact, because I saw what he had overlooked, some of the spirit towards the top of the tube. A few sharp jerks lowered it into position, and instead of the instrument registering 34° it registered a trifle more than 38° . He then saw that his " 27 degrees of frost" ought to have been something less than " 23 degrees," a little more than 9° above zero, instead of 5° . The frost, however, must have been unusually severe in Surrey, as at the Royal Horticultural Society's meeting, on December 9th, not only were aucubas shown blackened and soft, but leaves of the much hardier—ivy and rhododendron—were in a similar condition.

On asking for a shilling thermometer in an optician's shop in London, one was handed to me out of the drawer. I placed it on the counter and asked for another, then for a second and a third, and on seeing they all differed, the attendant willingly handed out more. Out of twenty-five, five were uniform, and one of these was chosen. I gave it to a neighbour for his little greenhouse, and it answers its purpose; but whether it is accurate or not I am not able to say, though it is probably nearer being correct than many are on which reports of frost are founded.

J. WRIGHT.

171, Fleet Street, London.

EARLY METEOROLOGY.

To the Editor of the Meteorological Magazine.

SIR,—You have dealt so often in the *Meteorological Magazine* with Pre-Instrumental Meteorology, that I am sure to awake your interest, and perhaps that of many of your readers, if I call your attention to the oldest regular record of weather of which I am aware.

Till now I was of the opinion that in Italy might be found the beginning of continuous weather observations (XV. century), without being able to say who first made such observations, only because the state of learning was then much higher in Italy than in all other European countries; and for the reason that more than one century later almost all meteorological instruments were invented in that country. But now I suppose this primacy is to Old England.

Reading in an early volume of the "Philosophical Transactions," I found in a paper published by Robert Plot, of Oxford (Number 169, 1685, March 23rd, page [931]), the following most interesting passage, which seems to be quite overlooked or forgotten:—

"The industrious *Walter Merle*, Fellow of *Merton Coll.* . . , observed the weather here at *Oxford* every day of the month, seven years together, viz., from *Jan.*, 1337, to *Jan.*, 1344; the MS. copy of which *Observations* are yet remaining in the *Bodleian Library*."

I suppose that it will be easy for you to ascertain if that MS. is still remaining there. If it is still existing, as I hope, efforts should be made by all means to have it published *in extenso*. It would be, without doubt, the most important historic document of meteorological observations. Tycho Brahe's *Meteorologiske Dagbog*, embracing the years 1582 till 1597, has been published by the Danish Academy of Sciences; how much more interesting would it be to have published observations made two centuries and a half earlier?

I remain, Sir, faithfully yours,

GUSTAVUS HELLMANN.

Berlin, December 9th, 1890.

[We tried to trace this MS. many years ago and failed. An Oxford friend has promised to make a fresh search in the course of a month, and we shall be happy to report the result.—ED.]

HAIL INSURANCE.

[Usually questions in which money is an essential feature are keenly debated, but it does not seem to be so with regard to the above. The only local notice which we have yet seen was a leader in the *Hunts County Guardian*; the writer seems to think that there is no justification for the extra charge, for he quotes the last sentence of our article introducing it by the following confirmatory words, "The Editor [of the *Met. Mag.*] comes to what appears to be a common-sense solution of the problem." If there existed any local impression that hailstorms in that district were extra frequent or extra violent, surely the leader writer of the county paper would know of it.

On the other hand we are very glad to have received the following letters, which may be regarded as evidence on the other side. That from the Secretary of the Insurance Company is most important, and we are much indebted to him for it. Unfortunately, it leaves us in as great a meteorological puzzle as ever; we thought that the injury was due to storms of exceptional violence; it appears that it is their exceptional frequency which creates the increased risk, but to what is this extra frequency due? After Mr. Vickers' statement we are not free to question the fact, although, as stated above, it does not seem to be known to the Editor of the local paper. But we have not the least wish to pry into the affairs of any company, and therefore should have preferred a statement of the percentages of loss in and outside the radius—or the ratio of one to

the other—either would give the data which we, as meteorologists, require, but would (fortunately) not give the slightest clue to the amount of business done by any company. Mr. Vickers may rest assured that we have no intention of trying to float a company, but we do intend to try to find out why hailstorms do twice as much damage in that part of the country as anywhere else.

As regards the second letter, bad as the storm was, it is only stated to have extended over $\frac{3}{4}$ mile by 3 miles; that is only about two square miles out of the 452 charged double, or less than $\frac{1}{2}$ per cent. We hope that the subject will be further elucidated.—ED.]

To the Editor of the Meteorological Magazine.

SIR,—Our attention has been drawn to the article on “Hail Insurance” in your November issue; and I beg to suggest that it is calculated to give—as it is evidently written under—a wrong impression. The article says, “Fourteen summers have passed, we have heard of no *exceptional storms* in the district singled out for double charges.” This, and one or two other expressions, seem to denote the idea that specially severe visitations are the cause of the extra rate in the Somersham radius. Such is not the case, however. It is simply that the district is peculiarly liable to hail storms.

While there have, perhaps, been no *peculiarly* disastrous hail storms in the Somersham radius during the period you mention—fourteen years—yet it would be erroneous to suppose that those which have occurred have been so slight as to cause no damage.

We have—since we derive a considerable amount of business from the area named—been at some trouble to ascertain the facts, so far as our experience goes, and the result of our investigations shows that but a poor prospect would await a “company of their own,” if the farmers of the neighbourhood adopted your suggestion, and formed one.

There has been a total profit, during the whole period, of about £500, and this is, of course, with the surcharge.—Yours faithfully,

B. VICKERS, *Secretary.*

The Midland Counties Insurance Co., Lincoln.

December 31st, 1890.

SIR,—I have just been reading in the *Meteorological Magazine* for November, the article on “Hail Insurance.” There was a very serious hailstorm about 1878, at Sawtry (which, as far as I can make out from the map, is just within 12 miles of Somersham) and extending in a narrow strip about three-quarters of a mile broad for two or three miles at least from Sawtry, in the direction of Somersham.

It occurred one Sunday in August, and the harvest was to commence generally in that district the next day; but on the land over which it passed no harvest was ever reaped, for the hail was so violent that it threshed the corn, and cut the straw to shreds, the root crops were also quite destroyed. I visited the place soon after and it was quite desolate, all the leaves were cut off the trees or

blackened on them, and the bark of the young shoots was cut and bruised. One farmer told me that he lost £1,700 worth of crops, and that he had not insured on account of the double rate. I did not see the storm myself, but a friend (since dead) told me that he measured several stones and found them 6 in. round, and that several tiles were broken on his house. All his poultry exposed to the storm were killed. I forget what year it happened, but, if it were of any use, fuller particulars could no doubt be obtained from persons living in the place.—Yours faithfully,

GEORGE KNOWLES.

Syrencot, Figheldean, Amesbury, S.O., Dec. 9th.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, December 17th, at the Institution of Civil Engineers, 25, Great George Street, Westminster; Mr. H. F. Blanford, F.R.S., Vice-president, in the chair. Dr. T. Fowler, Mr. A. Greg, and Mr. H. Woolcock, C.E., were elected Fellows of the Society.

The following papers were read:—

1. "Note on a Lightning Stroke, presenting some features of interest," by Mr. R. H. Scott, F.R.S. On January 5th, a house near Ballyglass, Co. Mayo, was struck by lightning, and some amount of damage done. A peculiar occurrence happened to a basket of eggs lying on the floor of one of the rooms. The shells were shattered so that they fell off when the eggs were put in boiling water, but the inner membrane was not broken. The eggs tasted quite sweet. The owner's account is that he boiled a few eggs from the top of the basket, the rest were "made into a mummy," "the lower ones all flattened, but not broken."

2. "Note on the effect of Lightning on a dwelling house," by Mr. A. Brewin, F.R.Met.Soc. This is an account of the damage done to the author's house at Twickenham, on September 23rd, 1890.

3. "Wind Systems and Trade Routes between the Cape of Good Hope and Australia," by Capt. M. W. C. Hepworth, F.R.Met.Soc. The author is of opinion that the best parallel on which commanders of vessels, navigating the South Indian Ocean between the Cape of Good Hope and the Australian Colonies, should run down the longitude is between the 41st and 42nd parallels during the winter months, and between the 45th and 46th parallels during the summer months.

4. "Report on the Phenological Observations for 1890," by Mr. E. Mawley, F.R.Met.Soc. Taking the year ending August, the weather of the autumn, winter, and spring, and of the first summer month, could scarcely have been more favourable for vegetation; while that of July and August proved altogether as unpropitious.

5. "The Climate of Hong-kong," by Dr. W. Doberck, F.R.Met. Soc. This is a discussion of the meteorological results at the Hong-kong Observatory, and at the Victoria Peak, during the five years, 1884-88.

REVIEW.

Klimaschwankungen seit 1700 nebst Bemerkungen über die Klimaschwankungen der Diluvialzeit. Von Dr. EDUARD BRÜCKNER, a.o., Professor der Geographie an der Universität zu Bern. [*Geographische Abhandlungen herausgegeben von Prof. Dr. ALBRECHT PENCK, Band IV., Heft 2.*] Wien, E. Hölzel, 1890. 8vo. viii.—324 pages, 13 diagrams, and one plate.

(Continued from our last.)

In concluding our notice of this important chapter, we give a tabular summary of the author's results for the whole globe. It should be mentioned that all his values are given for lustra, i.e., five-year periods, e.g., 1871-5; 1876-80, &c.; and he finds approximations to these periods in all parts of the world, although sometimes a dry period in one locality may last on while a wet one has set in elsewhere.

DRY PERIODS.			WET PERIODS.		
1716-1735	...	20 years.	1691-1715	.....	25 years.
1756-1770	.....	15 "	1736-1755	.....	20 "
1781-1805	.....	25 "	1771-1780	.....	10 "
1826-1840	.....	15 "	1806-1825	.....	20 "
1856-1870	.....	15 "	1841-1855	.....	15 "
			1871-1885	.....	15 "

The sixth chapter deals with variations of barometric pressure, and is largely based on Dr. Hann's work, published as an earlier volume of the same series; the seventh, with temperature; and the eighth, with the closing and opening of rivers, the time of vintage (based chiefly on Angot's work), the occurrence of severe winters, based chiefly on Pilgram's work* (which seems to be scarce). At the end of this chapter the author becomes definite as to the periodicity of the oscillations of climate, and fixes the average period to a tenth part of a year with a variability of about eight months, "eine Periode 34.8 ± 0.7 Jahren." Important, even extraordinary, as is the mass of data which the author has collected, we think that he is very courageous to express so definite an opinion.

We are too anxious to assist all who think that they can find a clue to the laws of weather changes to be hard upon anyone, and we are neither friends nor foes to sunspot theories, but we cannot help noting that 34.8 , divided by 3 , gives 11.6 , which does not differ much from a value one has heard of before.

However, be the verdict on the 34.8 years what it may, it is certain that by compiling this important work Dr. Brückner has done good service, and we regret that we know of no English publisher who would venture upon such a publication in our own language. The nearest that we have had to it, *Man and Nature*, by the Hon. G. P. Marsh, must, however, have been a success, as we have three editions of it.

* *Anton Pilgrams Untersuchungen über das Wahrscheinliche der Wetterkunde durch vielfährige Beobachtungen.* Zwei abtheilungen. Wien, 1788. 4to.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JUNE, 1890.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.									
England, London	78·2	25	40·8	1	69·0	50·9	49·3	0·100 73	124·8	36·9	2·82	17	6·5
Malta.....	86·2	25	58·1	3	79·1	63·4	61·4	74	140·2	49·8	·08	1	1·3
<i>Cape of Good Hope</i> ...	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mauritius</i>	77·0	22	56·6	14	74·1	63·5	60·3	77	127·7	45·6	1·52	16	5·1
Calcutta.....	95·7	1	71·4	6	89·7	78·0	78·9	84	156·8	70·9	13·40	21	6·9
Bombay.....	90·1	8	74·5	19	85·4	77·6	76·8	85	141·0	72·0	24·55	28	9·2
Ceylon, Colombo	87·7	9	73·8	17	85·4	77·9	73·8	78	146·0	72·0	1·87	15	7·7
<i>Melbourne</i>	66·0	5	38·0	30	58·7	48·0	47·8	83	115·0	31·9	1·71	13	7·4
<i>Adelaide</i>	67·8	7	39·6	29	61·3	49·9	49·0	79	130·3	32·0	4·22	17	6·6
<i>Wellington</i>	63·0	15	37·3	28	56·6	45·1	43·6	77	105·0	30·0	2·28	18	4·0
<i>Auckland</i>	65·0	27	44·0	23	60·5	50·9	48·9	79	118·0	35·0	3·74	16	6·7
Jamaica, Kingston.....	91·6	13	70·3	18	89·1	73·0	69·8	68	...	...	·44	...	...
Trinidad	89·0	19	65·0	30	85·5	70·0	70·7	77	156·0	62·0	9·68	22	...
Toronto.....	86·6	25	42·1	8	...	...	57·2	75	...	...	4·87	13	5·0
New Brunswick, Fredericton.....	83·2	17	37·5	12	...	...	49·0	73	...	...	5·14	17	7·0
Manitoba, Winnipeg ...	96·5	26	36·3	7	...	...	...	...	...	...	2·15	10	5·0
British Columbia, Victoria.....	74·0	5, 6	36·0	13	...	...	...	...	...	...	2·10	12	...

REMARKS.

MALTA.—Mean temp. 70°·0 ; mean hourly velocity of wind 9·0 miles. Sea temp. rose from 72°·0 to 77°·0. Thunderstorm on 5th. J. SCOLES.

Mauritius.—Mean temp. of air 1°·8 below, mean dew point 0°·2 below, and rainfall ·36 in. below their respective averages. Mean hourly velocity of wind 10·9 miles, or 0·6 below average; extremes 25·8 on 26th, and 1·7 on 6th; prevailing direction S.E. Unusual skyglows before and after sunrise throughout. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 3°·4, of dew point 4°·5, humidity 3, amount of cloud 0·8, above their respective averages. R·27 in. below average. Prevailing winds N., strong on 8 days. Heavy dew on 8 days. Fog on 6 days. Lightning on the 12th. R. L. J. ELLERY, F.R.S.

Adelaide.—The mean pressure was very low, 0·116 in. below the average; the mean pressure in June has been only four times lower during 33 years. The mean temp. 55°·6 was 2° above the average; the nights particularly being warm; the mean min. (49°·9) being 3°·1 above the average. Dew was registered on 14 nights, but there was an entire absence of frost. Although the number of rainy days was just the average, the total precipitation was 1·43 in. above the average. C. TODD, F.R.S.

Wellington.—Generally showery, but some fine pleasant weather at intervals; the rainfall below the average. Prevailing winds S.E. and N.W., strong from latter quarter on 7th and 17th. Hail on 1st. Mean temp. 1°·8 above the average. Rainfall less than half the average. R. B. GORE.

Auckland.—Warm and mild for the season, the mean temp. being 2 degrees above the average, and the rainfall only about half the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
 DECEMBER, 1890.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in			in.
II.	Dorking, Abinger Hall.	·68	XI.	Castle Malgwyn	...
"	Margate, Birchington...	·73	"	Builth(Llanwrtyd Wells)	1·42
"	Littlehampton	·68	"	Rhayader, Nantgwillt..	1·60
"	Hailsham	·48	"	Carno, Tybrith	1·03
"	Ryde, Thornbrough	·88	"	Corwen, Rhug	·84
"	Alton, Ashdell.....	·80	"	I. of Man, Douglas	2·68
III.	Oxford, Magdalen Col...	·55	XII.	Stoneykirk, Ardwell Ho.	2·64
"	Banbury, Bloxham	·58	"	New Galloway, Glenlee	1·80
"	Northampton	·55	"	Melrose, Abbey Gate...	1·36
"	Cambridge, Fulbourne..	·48	XIII.	N. Esk Res. [Penicuik]	2·55
"	Wisbech, Bank House..	·45	XIV.	Ballantrae, Glendrisaig	2·53
IV.	Southend	·57	"	Glasgow, Queen's Park.	1·04
"	Harlow, Sheering ...	·41	XV.	Islay, Gruinart School..	1·47
"	Rendlesham Hall	·59	XVI.	Dollar	2·32
"	Diss	·78	"	Balquhider, Stronvar..	1·43
"	Swaffham	·48	"	Coupar Angus Station..	1·77
V.	Salisbury, Alderbury ...	1·01	"	Dunkeld, Inver Braan..	1·29
"	Warminster	1·83	"	Dalnaspidal H.R.S.	1·54
"	Bishop's Cannings	1·16	XVII.	Keith H.R.S.	1·80
"	Ashburton, Holne Vic...	4·80	"	Forres H.R.S.	·51
"	Hatherleigh, Winsford.	2·31	XVIII.	Fearn, Lower Pitkerrie.	·39
"	Lynmouth, Glenthorne.	2·58	"	Loch Shiel, Glenaladale	...
"	Probus, Lamellyn	4·57	"	N. Uist, Loch Maddy ...	1·56
"	Launceston, S. Petherwin	4·44	"	Invergarry	·65
"	Wincanton, Stowell Rec.	2·07	"	Aviemore H.R.S.	1·09
"	Taunton, Lydeard Ho...	...	"	Loch Ness, Drumnadrochit	·62
"	Wells, Westbury	1·51	XIX.	Lairg H.R.S.	·77
VI.	Bristol, Clifton	1·30	"	Scourie	1·73
"	Ross	1·15	"	Watten H.R.S.	1·21
"	Wem, Clive Vicarage ...	·64	XX.	Dunmanway, Coolkelure	7·51
"	Cheadle, The Heath Ho.	·79	"	Fermoy, Gas Works	2·23
"	Worcester, Diglis Lock	·80	"	Tipperary, Henry Street	2·73
"	Coventry, Conndon	·80	"	Limerick, Kilcornan ...	2·41
VII.	Ketton Hall [Stamford]	·51	"	Miltown Malbay.....	2·85
"	Grantham, Stainby	1·58	XXI.	Gorey, Courtown House	2·68
"	Horncastle, Bucknall ...	·68	"	Navan, Balrath	...
"	Worksop, Hodsock Priory	·60	"	Mullingar, Belvedere...	·94
VIII.	Neston, Hinderton	·80	"	Athlone, Twyford	2·06
"	Knutsford, Heathside ..	·61	"	Longford, Currygrane...	1·82
"	Lancaster, Southfield ...	·15	XXII.	Galway, Queen's Coll...	2·20
"	Broughton-in-Furness ..	·96	"	Clifden, Kylesmore	4·39
IX.	Wakefield Prison	·77	"	Crossmolina, Enniscoe..	1·59
"	Ripon, Mickley	·58	"	Collooney, Markree Obs.	2·52
"	Scarborough, West Bank	·99	"	Ballinamore, Lawderdale	2·45
"	East Layton [Darlington]	·93	XXIII.	Warrenpoint	3·00
"	Middleton, Mickleton..	·83	"	Seaford	2·46
X.	Haltwhistle, Unthank..	·70	"	Belfast, New Barnsley..	2·44
"	Shap, Copy Hill	·44	"	Bushmills, Dundarave...	1·74
XI.	Llanfrehfa Grange	1·56	"	Stewartstown	1·66
"	Llandovery	1·01	"	Buncrana	2·16

DECEMBER, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					TEMPERATURE				
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Days on which $\frac{1}{10}$ or more fell.	Max.		Min.		In shade.
				Dpth.	Date.		Deg.	Date.	Deg.	Date.	
I.	London (Camden Square) ...	·68	— 1·39	·21	18	9	43·7	4	14·9	22	25·27
II.	Maidstone (Hunton Court)...	·59	— 1·65	·20	20	5	...	...	...	...	...
III.	Strathfield Turgiss	·85	— 1·16	·25	18	10	43·9	5	7·5	22	24·27
IV.	Hitchin	·67	— 1·36	·18	18	10	44·0	4	5·0	21	26·...
V.	Winslow (Addington)	·62	— 1·83	·23	18	10	42·0	3, 4	1·0	22	26·28
VI.	Bury St. Edmunds (Westley) ..	·78	— 1·46	·16	19	10	42·0	4	6·0	21	...
VII.	Norwich (Cossey)	·51	— 1·72	·15	3	6	...	...	...	...	...
VIII.	Weymouth (Langton Herring) ..	1·63	— 1·47	·85	18	12	43·0	1, 3	18·0	31	24·...
IX.	Barnstaple	1·04	— 3·65	·45	1	7	45·0	4, 5	21·0	31	...
X.	Bodmin (Fore Street)	5·81	+ ·47	1·55	18	20	...	...	...	...	...
XI.	Stroud (Upfield)	1·08	— 1·37	·43	18	11	41·0	1, 4	17·0	14	27·...
XII.	Churchstretton (Woolstaston) ..	·81	— 2·24	·13	25	16	44·5	1	17·0	20	25·29
XIII.	Tenbury (Orleton)	1·32	— 1·05	·41	18	13	45·0	1	1·5	22	25·26
XIV.	Leicester (Barkby)	·49	— 1·65	·13	4	12	44·0	1	3·0	21	27·31
XV.	Boston	·49	— 1·36	·20	26	4	44·0	4	12·0	21	25·...
XVI.	Hesley Hall (Tickhill)	·53	— 1·45	·14	4	12	44·0	4	10·0	21	25·...
XVII.	Manchester (Plymouth Grove) ..	·37	— 3·07	·33	19	2	45·0	1, 4	10·0	19	21·30
XVIII.	Wetherby (Ribston Hall)	·67	— 1·77	·23	18	5	...	...	...	...	...
XIX.	Skipton (Arncliffe)	1·05	— 5·76	·18	24	10	48·0	2	19·0	13	17·...
XX.	Hull (Pearson Park)	·86	— 1·41	·21	4	11	...	...	...	...	...
XXI.	North Shields	1·30	— 1·04	·28	25	13	50·0	1	...	...	...
XXII.	Borrowdale (Seathwaite)	1·21	— 13·60	·32	25	9	...	...	...	...	...
XXIII.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...
XXIV.	Haverfordwest	2·51	— 2·48	·83	18	11	50·0	1	19·0	31	22·30
XXV.	Plinlimmon (Cwmsymlog)	·86	...	·40	1	5	...	...	...	...	...
XXVI.	Llandudno	1·31	— 1·65	·20	1a	11	...	...	...	...	...
XXVII.	Cargen (Dumfries)	·95	— 3·07	·56	2	4	51·8	1	18·0	14	25·...
XXVIII.	Jedburgh (Sunnyside)	1·71	— ·49	·70	26	10	48·0	2	12·0	13a	16·...
XXIX.	Old Cumnock	1·71	— 3·36	1·20	2	7	53·0	1	17·0	20	26·...
XXX.	Lochgilthead (Kilmory)	1·53	— 5·84	·40	1	10	...	...	...	...	...
XXXI.	Oban (Craigvarren)	1·37	...	·61	1	7	52·0	1	26·6	19	7·...
XXXII.	Mull (Quinish)	1·51	— 6·06	·43	1	10	...	...	...	...	...
XXXIII.	Loch Leven Sluices	2·70	— ·61	1·10	3	10	...	...	...	...	...
XXXIV.	Dundee (Eastern Necropolis) ..	2·20	+ ·12	·90	2	13	52·5	1	22·7	22	13·...
XXXV.	Braemar	·43	— 2·04	·09	4	14	51·8	1	16·0	21	24·29
XXXVI.	Aberdeen (Cranford)	3·02	— ·83	2	25	56·0	1	18·0	21	10·...	...
XXXVII.	Strome Ferry	1·58	— 6·21	·37	1	13	...	...	...	...	...
XXXVIII.	Inverness (Culloden)	·55	— 1·38	...	...	...	55·0	1	23·0	7, 18	22·29
XXXIX.	Dunrobin	·71	— 2·66	·29	26	7	56·0	1	25·0	18	13·...
XL.	S. Ronaldsay (Roeberry)	1·47	— 2·19	·19	27	18	53·0	1	31·0	19	2·...
XLI.	Cork (Blackrock)	3·64	— ·52	·81	18	13	52·0	1	25·0	16	13·...
XLII.	Dromore Castle	4·89	— 1·74	·80	11	13	57·0	21	25·0	30	...
XLIII.	Waterford (Brook Lodge)	3·62	— ·02	·82	18	14	51·0	1	24·0	31	13·...
XLIV.	O'Briensbridge (Ross)	2·48	...	1·53	10	8	51·0	1	24·0	e	24·...
XLV.	Carlow (Browne's Hill)	2·56	— ·56	·75	18	13	...	...	...	...	...
XLVI.	Dublin (Fitz William Square) ..	1·86	— ·30	·60	2	11	53·9	1	24·1	21	8·23
XLVII.	Ballinasloe	1·89	— 1·53	·90	11	10	49·0	1	18·0	21c	26·...
XLVIII.	Waringstown	2·68	— ·36	1·30	2	17	54·0	1	22·0	21c	18·23
XLIX.	Londonderry (Creggan Res.)	1·82	— 2·39	·98	18	14	...	...	...	...	...
L.	Omagh (Edenfel)	2·01	— 1·67	·66	18	16	52·0	1	18·0	20	17·23

a And 18, 22. b And 31. c And 22. d And 14. e frequently.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON DECEMBER, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A month of unprecedented severity. With the exception of the interval from the 3rd to the 6th, there was uninterrupted frost, the maximum on 14 days not reaching the freezing point, while on the 22nd, the minimum in the Stevenson stand dropped to 7°·5, and on the grass (the snow having been swept away) fell to 4°·5 (both thermometers being in exact working order, and Kew corrections applied). The snow was not heavy, the greatest fall yielding ·25 inch on the 18th.

ADDINGTON.—Remarkable for the small amount of R and the long-continued frost, (lasting, without a single break, from the 7th until the end) often of great severity. From the 13th until the end, the max. shade temp. was never above 32°. The coldest December recorded here.

BURY ST. EDMUNDS, WESTLEY.—The month was remarkable for the high and very steady bar., the variation in the last ten days not exceeding a tenth of an inch. It was also extremely cold, with very severe frosts and wind, chiefly from the east.

LANGTON HERRING.—An exceptionally cold month, the absolute max. being only 43°, while the previous lowest max in December was 50° in 1879. The lowest max. in January has been 48° in 1881, and in February, 48° in 1873. Comparison with other cold months shows :—

MEANS.

	9 a.m.		Min.		Max.
December, 1878 ...	33°·5	.....	29°·8	.....	38°·3
January, 1879 ...	32°·8	.....	30°·1	.....	36°·7
January, 1880 ...	33°·6	.....	31°·5	.....	38°·0
January, 1881 ...	29°·9	.....	27°·8	.....	36°·0
December, 1890 ...	31°·0	.....	29°·0	.....	34°·5

The mean max. was 10°·1, the mean min. 7°·7, the mean at 9 a.m. 8°·9 below the average.

BODMIN, FORE STREET.—A very cold month, with more than the average R and exceedingly hard frost, especially in the last week. Very little snow, but high cold N.E. winds; one of the old fashioned Decembers, and the coldest for many years.

STROUD, UPFIELD.—The max. temp. in shade, was above 32°, on only 11 days.

WOOLSTASTON.—A very severe month. The frost, which commenced on the 3rd, continued throughout with only some occasional slight thaws of an hour or two duration, but no exceptionally low temperature, was reached. S fell on 10 days, but not very heavily. Mean temp., 29°·4.

ORLETON.—The coldest December recorded here; the mean temp. 29°·8, being 8°·5 below the average of 29 years. On 13 days the temp. never reached 32°, and the max. for the month, 45° on the 1st, is the lowest max. registered in any month. On the night of the 21st, the thermometer on the grass fell to -1°·7, the lowest reading since January 3rd, 1867. The Teme and the Severn were both frozen over on 22nd. Deep S on 18th and 23rd. Fine S on 8th, 25th, 26th, 27th, 30th and 31st.

LEICESTER, BARKBY.—Mean temp. of month 28°·7. Min. temp. for the 13th, 14th, 20th, 21st, 22nd, and 29th respectively, 12°, 13°, 5°, 3°, 8°, 10°.

MANCHESTER, PLYMOUTH GROVE.—Mean temp. 32°. Dense fog on the 14th, 15th, 20th, and 21st. On the 19th and 21st the grass min. fell to 5°. S on the 19th.

HULL, PEARSON PARK.—The weather during the month was generally overcast, often with mist or fogs and frost, more or less severe every night, except the 1st, 4th, 5th, 8th, 9th and 10th. Slight falls of H or S occasionally on and after the 15th. Winds very cold, generally easterly.

WALES.

HAVERFORDWEST.—The month commenced rainy and mild, but on the 4th the wind shifted to the N. and N.E. ; temp. fell rapidly, and persistent frost prevailed to the end of the month ; severe at the middle, and especially so in the last week, when the temp. was uniformly low day and night, and did not exceed 32° on seven days. The night temp. was rather low at times, but did not approach the severity of 1870, '74, '78 and '79 Decembers. The temperature was, however, much below the mean. Winds from the 8th to 24th chiefly N. and N.E., while in the last seven days it blew with great bitterness and force from the E.

SCOTLAND.

CARLEN.—The mean temp. of the month is 5°·3 below the average. Easterly winds (N.E., E. and S.E.) prevailed for 23 days, generally with more or less fog, only 25 hours of sunshine being recorded ; while the average is 57 ; B the smallest recorded in December. On several occasions the barometer fluctuated more than half an inch in 24 hours, but produced little change in the general character of the weather.

JEDBURGH.—The weather was still though cold, and although the degree of frost was considerable, country work was not delayed.

OBAN.—Immediately after the 2nd fair and cold weather set in, which lasted to the close, and has been very beneficial to the farmers.

CULLODEN.—Continued frost during the whole month, without, however, either snow or fog. Weather otherwise pleasant. Very little E.

IRELAND.

CORK.—A cold raw and damp month. S at night on 30th, and most of the 31st, but it all disappeared in the night. Mean temp. 39°·3.

DROMORE.—The beginning of the month was wet, and it continued so till the last week, when easterly winds set in and it became bitterly cold, with a hard frost till the 31st, when there was a slight sprinkling of snow.

WATERFORD, BROOK LODGE.—A good deal of easterly wind during the month. Mean temp. 38°·5. H showers on the 11th. Gale from S.W. on the 18th. S on the 27th and 30th.

O'BRIENSBRIDGE, ROSS.—Sharp frosts very frequent, and the mean temp. for 24 hours often below 32°. Prevailing wind, N.E., and very bitter in the last week.

DUBLIN.—A very cold, dull, foggy month, with much cloud (7·6) and prevalent E. winds. Mean temp 39°·2, 2°·1 below the average. In December, 1878, the coldest in the 25 years ending 1889, the mean temp. was 32°·8. High winds on 10 days, gales on 2. Fog on 10 days ; S or sleet on 3 ; H on 6 days. Very dry piercing E. winds, from 28th to 31st.

WARINGSTOWN.—Frost, sharp and pretty continuous, but not remarkable here.

EDENFEL.—The mild wet weather of November extended in a modified degree to the 7th of this month, when it gave place to a cold period, that occupied with but little intermission the rest of the month. On the 18th and 19th a considerable quantity of S fell, but except on the nights of 19th, 20th and 21st, during which the temp. on the surface of the S reached 13°, there was no continuance of severe frost.

“On Barometric Oscillations during Thunderstorms, and on the Brontometer, an Instrument designed to facilitate their Study.” By G. J. SYMONS, F.R.S. Received April 24, 1890.

The fact that a rise of the barometer occurs during thunderstorms has been supposed by many to be newly discovered through the general establishment of self-recording barometers; but Dr. Hellmann has shown that it was noticed by J. J. Planer as far back as 1782. In 1784, Rosenthal epitomised the facts as follows:—“When a thunderstorm approaches the place where a barometer is situated, the mercury in the tube begins to rise; the nearer the thunder-cloud comes to the zenith of the observer, the higher does the mercury rise, and it reaches its highest point when the storm is at the least distance from the observer. As soon, however, as the cloud has passed the zenith, or has become more distant from the observer, the weight of the atmosphere begins to decrease and the mercury to fall.” A few years later, Toaldo determined the amount of the rise in several storms, and found it to be between 1 and 2 lines (0·09 in. to 0·18 in.).

Professor Strehlike (in 1827–30) made several sets of observations, and found the rise to be from 0·04 in. to 0·06 in., and was probably the first to point out that the highest point of the barometer is not absolutely synchronous with the passage of the centre of the storm-cloud, but seems rather to be always at a certain distance from it.

Kaemtz, in his ‘Lehrbuch’ (1832), suggests that the rise is produced by the inrush of air towards the site of the storm, this accumulation causing the rise of the barometer as the storm nears the zenith.

Although Luke Howard had a recording barometer at work in the early part of this century, he seems to have failed to notice the

phenomenon; and no one in England seems to have been aware of it until the photographic barometer was started at the Radcliffe Observatory, Oxford. Manuel Johnson, when describing the new instruments at the British Association meeting at Glasgow, in 1855, said:—

“Among the most remarkable results is a sudden rise of the barometer, amounting to 0·035 in., and an increase of temperature of 1°, coincident with the occurrence of a thunder clap which struck one of the churches in Oxford, July 14th, 1855. A similar phenomenon took place during a thunderstorm on August 23rd, when the rise of the barometer was still greater, amounting to 0·049 in., though the thunder clap coincident with this rise was distant.”

Mr. Johnson returned to the subject in the volume of ‘Radcliffe Observations’ for 1857, and gave reproductions of fourteen barograms, but the scale is so compressed (only $\frac{1}{4}$ in. per hour, and $1\frac{1}{2}$ in. per inch of mercury) that not much is to be learned from them beyond the fact of falls occurring of 0·037 in., 0·040 in., and 0·046 in., and a rise of 0·070 in.; the notes on the storms are also too vague to be useful. It may, however, be well to quote the conclusion at which Mr. Johnson arrived, viz.:—

“A comparison of these notes with the accompanying illustrations cannot, in my opinion, fail to lead to the inference that the disturbances exhibited both on the barometric and the thermometric curves (especially the former) are caused by the presence of electricity in the atmosphere, of which we had on these occasions sensible proof. But they are the more interesting, from the circumstance that similar disturbances occur not unfrequently when there has been no overt manifestation of that agency; especially during the winter months, when, according to the concurrent testimony of all observers, atmospheric electricity is most abundant.”

The next observation of importance is one quoted by Le Verrier, as reported to him by the observer, M. Goullon, Curé of Saint-Ruffine (Moselle). He had two barometers, a mercurial and an aneroid. On the morning of February 5th, 1866, the weather being stormy with heavy rain, wind S.W., moderate, but not squally, he had just set and read his barometers, when there was a solitary loud clap of thunder, and instantly both his barometers rose 2 mm. (0·08 in.).

The Hon. Ralph Abercromby began studying these oscillations in 1868, and in 1875 summed up the results in the following sentences, one descriptive, the other explanatory:—

“There are two classes of storm in this country: in the one the barometer rises, in the other it falls. In the case in which it rises, the sequence of weather is somewhat as follows:—After the sky has come overcast, the wind hushed to an ominous silence, and the clouds seem to have lost their motion, the barometer begins to rise suddenly.

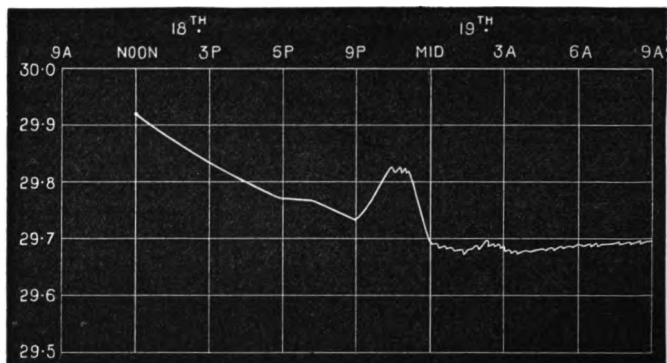
In the middle of this rise, sudden heavy rain begins. After a few minutes the rain, with or without thunder and wind, becomes a little less heavy, and the barometer sometimes falls a little. The rain then continues till the end of the squall, and as it stops the barometer returns to its original level. In Great Britain the rise rarely exceeds 0.10 in., or lasts more than two hours. These rises are always superadded to a more general rise or fall of the barometer, due either to a cyclone or to one of the small secondaries which are formed on the side of one. During some rises the wind remains unchanged; with others there is a more or less complete rotation of the wind. In all cases the disturbance seems to be confined to the lower strata of the atmosphere." "Since the rise is always under the visible storm, it is propagated at the same rate and in the same manner as the thunderstorm. Enough is known of the course of the latter for it to be certain that they are not propagated like waves or ripples, and hence these small barometric rises are not due to aerial waves, as has been suggested. Since their general character is the same whether there is thunder or not, it is evident that electricity, even of that intensity which is discharged disruptively, is not the cause of the rise. If we look at a squall from a distance, we always see cumulus above it, which is harder or more intense in the front than in the rear of the squall. Since cumulus is the condensed summit of an ascensional column of air, it is evident that the barometric rise takes place under an uptake of air. If we consider further that a light ascensional current would give rise simply to an overcast sky, a stronger one to rain, while a still more violent one would project the air suddenly into a region so cold and dry that the resulting electricity would be discharged disruptively as lightning, the foregoing observations show that the *greatest rise is under the greatest uptake*. Our knowledge of the mechanics of fluid motion is still too unsettled for us to say with certainty whether or not an ascensional current of air would have a reaction backwards, like a jet of air issuing from an orifice."

Professor Mascart also, in 1879, expressed the opinion that electricity had nothing to do with these oscillations, but suggested quite a different explanation. Premising that they are not produced by all heavy rains, but only when heavy showers fall during bright weather, he suggested that at such times rain falls through non-saturated air, where it would evaporate freely, and so produce a local increase of pressure which in certain thunder-rains might amount to 2 mm. (0.08 in.). He explained the diminution of pressure which sometimes occurs, by the reversed phenomenon; he considered that thunderstorms are formed locally, and suggested that the condensation of masses of vapour into rain drops ought to produce a diminution of pressure.

M. Teisserenc de Bort and Mr. Budd have suggested that the rise may be due to the local compression of the air by the multitude of falling rain drops.

In the 'Annales' of the French Meteorological Office for 1880, M. Renou gives reproductions of some barograms from the Observatory at Parc St.-Maur. A very interesting one is reproduced in fig. 1. M. Renou does not append any remarks to the plate; but

FIG. 1.



Parc St.-Maur, Paris, August, 1878.

from other sources it appears that there was a heavy thunderstorm from 10 till 11 P.M. on August 18th, 1878. The total rise may be taken as 0.10 in. and the fall as nearly 0.15 in.

Dr. Fines, of Perpignan, established a Redier barograph in 1875, and in a memoir published in 1883 gives reproductions of the traces during several storms. He states that, considering the present imperfect knowledge of the real conditions and origin of thunderstorms, it seems useless to try to explain records frequently influenced by very distant storms. One fact, however, is certain, that thunderstorms are accompanied by great condensation, which must cause variations in the density of the air, and therefore should affect the barometer. He gives 0.144 in. in 20 minutes as the greatest variation, but says that it rarely exceeds 2 mm. or 3 mm. (0.08 in. or 0.12 in.) in an hour. The only facts which are certain from the records at Perpignan are that there is usually (1) before heavy rain, decrease of pressure and temperature; (2) with the rain, sudden increase of wind, rapid rise of barometer, and fall of temperature; (3) at the end of the storm-rain, reversal of the last three phenomena.

Dr. Ciro Ferrari, who has devoted great attention to the progress

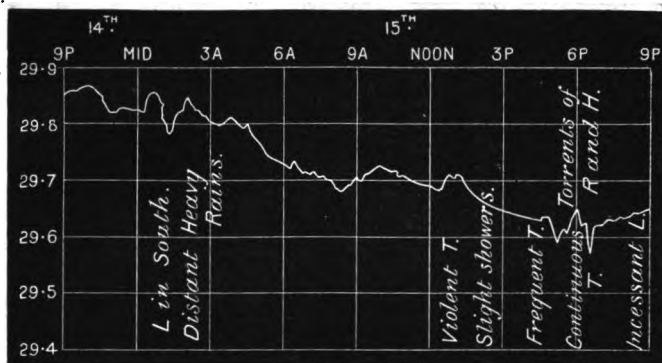
and character of the thunderstorms of North Italy, considers the rise due to secondaries on the skirts of cyclones.

Professor Börnstein regards them as due to temperature changes not reaching to the upper strata of the atmosphere, in which view he has partly the support of Professor Ferrel.

Professor Klossovsky, of Odessa, says that, "Every storm, whether with or without hail, is accompanied by barometric oscillation." If by this phrase he means oscillations like those observed in other parts of Europe, the phenomena must be different in Southern Russia, for one of the difficulties in London, for example, is that they do not occur with *all* storms, but only with *some*.

In the 'Annuaire' of the Montsouris Observatory for 1889, M. Descroix, when referring to the subject, gives a barogram for August 15th, 1888, which, with the accompanying notes, is so typical that it is reproduced (reduced to the same scale as the others) in fig. 2.

FIG. 2.

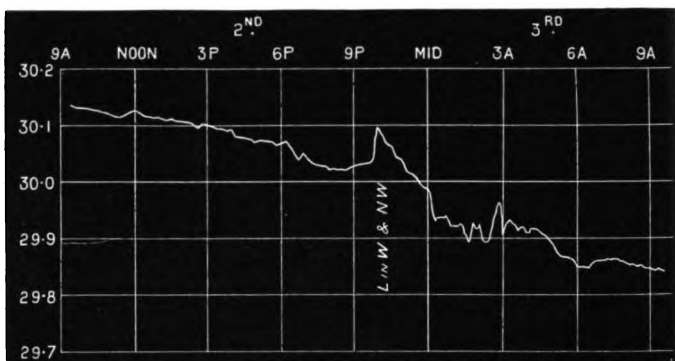


Montsouris, Paris, August, 1888.

It will be noticed that several of the opinions above quoted are contradictory, and it is not known that any one explanation is generally accepted.

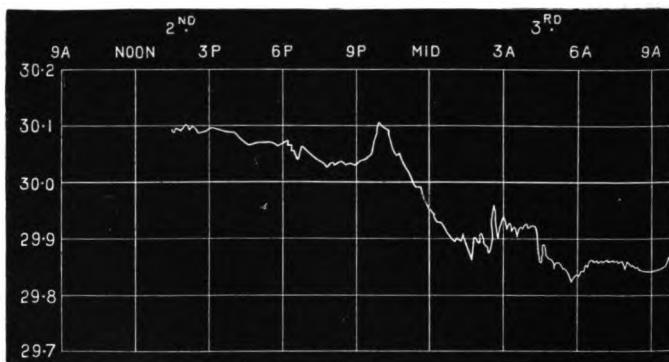
The author was much struck by the remarkable curve given by his Redier barograph on the evening of August 2nd, 1879, and still more so when he found that the curve from a similar instrument at Messrs. Lund and Blockley's, in Pall Mall, 2½ miles S. by W. from his own instrument, was nearly identical (figs. 3 and 4), and he has long desired to investigate the subject. At last, in 1886, he definitely decided upon the phenomena which he considered it necessary to record mechanically. The author had read the description of Sir Francis Ronalds's storm clock, and the objects being similar, that

FIG. 3.



Camden Square, London, August, 1879.

FIG. 4.



Pall Mall, London, August, 1879.

description was useful, though the completed apparatus has scarcely one feature which even resembles Sir Francis's.

Before describing the instrument, the author considers it only fair to MM. Richard Frères, to state that not only has the apparatus been constructed, but almost wholly invented, by them; the author decided upon what the instrument was to do, and upon the scales required, but he left the whole constructional details to MM. Richard, and considers the result a great credit to the firm.

As the primary object of the instrument* is the study of the phenomena of thunderstorms, it has, for brevity, been termed a Brontometer, or Thunderstorm-measurer.

* Other uses for it are already apparent.

It is provided with endless paper, 12 in. wide, travelling under the various recording pens at the rate of 1.2 in. per minute, or 6 ft. per hour. This is about 150 times faster than is usual in meteorological instruments, and enables the time of any phenomenon to be read off with certainty to a single second of time.

The traces are made in aniline ink by a series of seven Richard pens.

The first pen is driven by the clock which feeds the paper, so that the time scale and the paper must go together. The pen usually produces a straight line, which serves as the base line for all measurements, but at 55 seconds after each minute the pen begins to go, at an angle of about 45° , one-tenth of an inch to the left, and at the sixtieth second it flies back to its original position.

The second pen is driven by one of Richard's Anemo-cinematographs, a name which they have given to a pattern of anemometer not yet known in England. The external portion has some resemblance to the ordinary windmill governor, but it differs from it in that the plates are curved, not flat; they are made of aluminium, and are so light that they have little momentum, and have thus a great advantage over cups, which run on for many seconds after the wind force has decreased or ceased. The fans make one revolution for each metre of wind that passes, and send an electric current to the brontometer, where it acts on an electro-magnet, and tends to draw this (2nd) pen towards the left; but a train of clockwork is constantly tending to draw the pen to the right, the joint result being that the pen continuously shows, not the total motion (as is the case with most anemometers), but the actual velocity almost second by second. It does this certainly with an error of less than five seconds, for the fans will stop dead in less than that time, and the clockwork train will bring the pen from indicating a velocity of 70 miles an hour to 20 miles an hour in three seconds, and down to a dead calm in seven seconds. The trace will thus resemble that of a pressure anemometer, but with a much more open scale than was ever before available.

The third pen is actuated by a handle, and can be set at zero or at 1, 2, 3, or 4 spaces from it. The author's original idea was, partly by watching a storm-rain-gauge, and partly by estimation, to decide on the intensity of the rain and to indicate that intensity by moving the pen further and further from zero as the fall becomes heavier. Experience alone will show whether that is, or is not, superior to moving it one step for each $\frac{1}{16}$ th of an inch of fallen rain, which can be done by making a Crosley rain-gauge send a current into the room where the brontometer is placed, and strike a bell there. In a heavy storm there will, however, be so much for the observer to do, that very probably count would be lost. It may, therefore, be necessary to make it act automatically.

The fourth pen is actuated somewhat like a piano. On the occurrence of a flash of lightning, the observer presses a key, the pen travels slightly to the right, and flies back to zero. Referred to the automatic time-scale, this gives, to a second, the time at which the key was depressed.

The fifth pen is similar, but, being intended to record the thunder, the observer will continue to hold down the key until the roll is inaudible. The time of the departure of this pen from zero will evidently be later than that for the lightning by the time-interval due to the distance of the flash, and possibly something may be learned from the accurate record of the duration of the thunder.

The sixth pen is similar to the third, and is intended to record the time, duration, and intensity of hail.

The seventh and last pen is devoted to an automatic record of atmospheric pressure. As the rapid motion of the paper, which is indispensable for studying the details of a thunderstorm, has enlarged the time-scale more than a hundredfold, it was imperative that the barometric scale should itself be greatly enlarged. But the range of the barometer in London is more than $2\frac{1}{2}$ in., and no enlargement less than ten times the natural (mercurial) scale would be of any use; hence a breadth of 25 in. of paper would be necessary, unless some mode of shifting the indication could be devised.

Several plans were tried, but finally a modification of Richard's statoscope has been adopted, which is so sensitive that it will indicate the opening or shutting of a door in any part of the house, gives a scale of 30 in. for each mercurial inch (*i.e.*, about three times that of a glycerine barometer), and yet only requires 4 in. breadth of the brontometer paper. Without entering into all the details of construction, it is desirable to explain the general principle, and its application. As it was essential that the apparatus should record accurately to 0.001 in. of mercurial barometric pressure, it was evident that friction had to be reduced to a minimum, and considerable motive power provided. This is done by placing in the base of the brontometer a galvanized iron chamber, which contains about $3\frac{1}{2}$ cubic feet of air; on the upper part are a series of elastic chambers, similar to the vacuum boxes of aneroid barometers, but much larger.

When the instrument is to be put in action, these chambers are connected with the large air-chamber, and a tap is closed which shuts off communication with the external air. Any subsequent increase, or decrease, of atmospheric pressure will compress or allow to dilate the air in these chambers, and the motion of the elastic ones produces that of the recording pen.

Obviously, any large change in the temperature of the confined air would vitiate the readings; but (1) the instrument is not required to give absolute, but merely differential, values, and (2) the influence

of the changes of temperature is greatly reduced by the chamber being surrounded with 4 in. thick of non-conducting material, besides nearly 1 in. of wood outside of it. The change of temperature in a room, and during the short time that the statescope will be worked without resetting to zero (*i.e.*, without opening the tap), has not hitherto produced any measurable effect.

The author hopes, in a subsequent paper, to have the honour of laying before the Society the results obtained from this novel apparatus.

Appendix.

List of some Papers and Memoirs on the subject of the Paper.

- PLAÑER, J. J. "Obs. Oscillationis Mercurii in Tubo Torricelliano Erfordie instituta." 'Acta Acad. Moguntinae,' 1782-3.
- ROSENTHAL, G. E. ["Merkmale für das Herannahen d. Gewitter."] 'Mag. Neueste Physik,' vol. 4, Part I, 1786.
- TOALDO, G. "Dei moti del Barometro nei Temporalì." 'Giornale Astro-Meteorologico,' 1794.
- (The note is dated April 3rd, 1795; see also his collected works—'Completa Raccolta, &c.,' Venezia, 4 vols., 8vo., 1802, vol. 3, p. 104, and vol. 4, p. 41.)
- FRENZEL, F. C. ["Veränderung d. Barometerstandes bei Gewittern."] Gren's 'Neues Journal der Physik,' vol. 4 (1797), p. 250.
- GRONAU, K. L. "Ueber die Gewitter in den Gegenden von Berlin." 'Schweigger's Journal,' vol. 31 (1821), p. 128.
- STREHLKE, F. "Ueber d. Einfluss d. Gewitter auf den Barometerstand." 'Poggendorff's Annalen,' vol. 19 (1830), p. 148.
- KAEMTZ, L. F. 'Lehrbuch der Meteorologie,' vol. 1 (1831), p. 351.
- JOHNSON, M. J. "On the Detection and Measurement of Atmospheric Electricity by the Photo-barograph and Thermograph." 'British Assoc. Report,' 1855, Part II, p. 40.
- 'Meteorological Observations made at the Radcliffe Observatory, Oxford,' 1857, p. 34.
- GOULLON. "Élévation brusque du Baromètre pendant un Coup de Tonnerre." 'Bulletin International,' Mars 21, 1866.
- WHITEHOUSE, W. "On a new Instrument for recording minute Variations of Atmospheric Pressure." 'Roy. Soc. Proc.,' vol. 19 (1871), p. 491.
- ABBECROMBY, Hon. R. "On the Barometric Fluctuations in Squalls and Thunderstorms." 'Meteor. Soc. Quart. Journ.,' vol. 2 (1875), p. 450.
- FINES. "Courbes du Barographe Redier à Perpignan pendant les Orages des 7 et 11 Juillet, 1877." 'Quinzaine Météorologique,' 1877, p. 66.
- MASCART, E. "Sur l'Inscription des Phénomènes Météorologiques, en particulier de l'Électricité et de la Pression." 'Journal de Physique,' vol. 8 (1879), p. 329; and 'Annuaire de la Soc. Mét. de France,' vol. 28 (1879), p. 7.
- SCHENZL, G. "Ungewitter vom 23 Februar, 1879." 'Zeits. d. Oesterr. Gesells. f. Meteor.,' vol. 14 (1879), p. 146.
- RENOU, E. [Diagrams only.] 'Annales du Bureau Central Météor.,' 1880, Part I.

FINES. "Climatologie du Roussillon."

'Annales du Bureau Central Météor.,' 1881, Part I, B. 118.

ASSMANN. [Interesting reproductions of the Magdeburg barograph curves are given in the 'Jahrb. der Meteor. Beob. der Wetterwarte der Magdeburgischen Zeitung,' Jahr. 1—5, Magdeburg, 1883—87.]

KÖPFEN. "Ueber Barometerschwankungen beim Gewitter."

'Tageblatt der 57 Naturforscherversammlung zu Magdeburg,' 1884, p. 301.

HELLMANN, G. "Eine historische Bemerkung."

'Zeits. d. Oesterr. Gesells. f. Meteor.,' vol. 19 (1884), p. 43.

BEZOLD, W. VON. "Ueber die Vertheilung des Luftdruckes und der Temperatur während grösserer Gewitter."

'Zeits. d. Oesterr. Gesells. f. Meteor.,' vol. 19 (1884), p. 281.

SCHÖNROCK, A. "Ueber Kleine unregelmässige Schwankungen des Luftdruckes nach den Aufzeichnungen des Barographen."

'Zeits. d. Oesterr. Gesells. f. Meteor.,' vol. 19 (1884), p. 396.

FERRARI, C. "Ueber die Vertheilung des Luftdruckes und der Temperatur bei Gewittern."

'Zeits. d. Oesterr. Gesells. f. Meteor.,' vol. 19 (1884), p. 426.

— "Andamento tipico dei Registratori durante un Temporale."

'Annali Meteorologia Italiana,' vol. 7 (1885), Part I, p. [65].

— "Ueber die Krümmung der Barometer-curve während des Gewitters."

'Das Wetter,' vol. 1 (1885), p. 135.

SCHÖNROCK, A. "Ueber kleine unregelmässige Barometer-Schwankungen."

'Wild's Repertorium,' vol. 9 (1885), No. 8.

KLOSOWSKY, A. 'Les Orages en Russie.' Odessa, 1886.

BÖRNSTEIN, R. "Die Gewitter vom 13—17 Juli, 1884, in Deutschland."

'Zeits. f. Meteor.,' vol. 22 (1887), p. 443.

LESS, E. "Ueber kurze Luftdruckschwankungen, welche in Begleitung stärker Blitzschläge auftreten."

'Zeits. f. Meteor.,' vol. 23 (1888), p. 151.

DESCROIX, L. "Phénomènes accidentels . . . à Montsouris en 1888."

'Ann. de l'Obs. de Montsouris pour 1889,' p. 195.

FREBEL, W. 'A Popular Treatise on the Winds,' 1889.

7 DAY USE
RETURN TO DESK FROM WHICH BORROWED
EARTH SCIENCES LIBRARY

**This publication is due on the LAST DATE
and HOUR stamped below.**

RB 17-60m-3,'66
(G1105s10)4188

General Library
University of California
Berkeley

-894

